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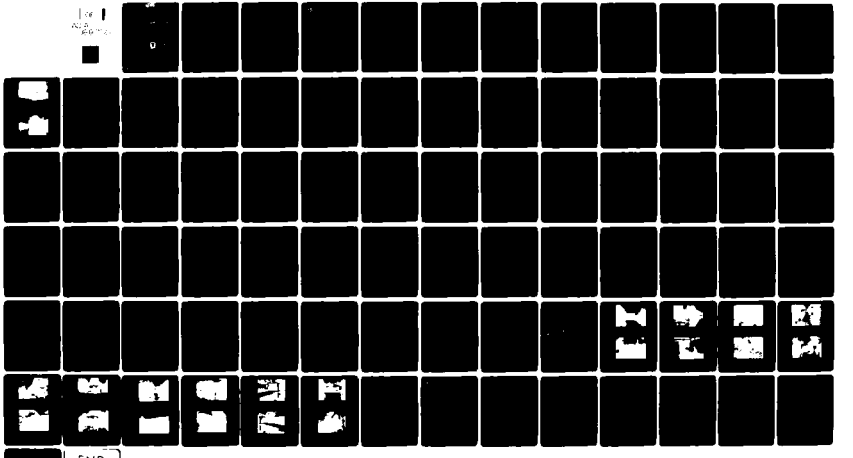

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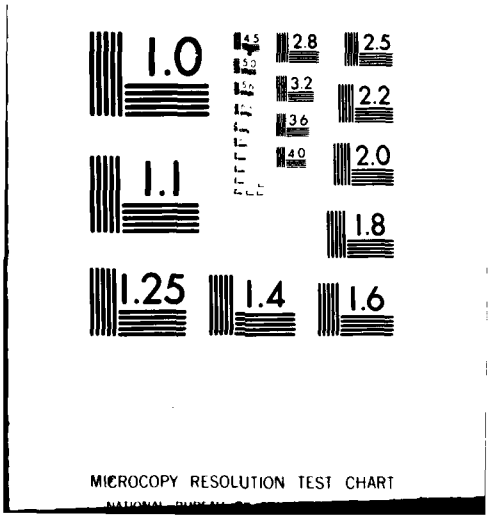
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DELAWARE RIVER BASIN
WELDON BROOK
MORRIS COUNTY
NEW JERSEY

LAKE SHAWNEE DAM

NJ 00334

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

SEPTEMBER 1980

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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4. TITLE (and Subtitle) Phase I Inspection Report National Dam Safety Program NJ00334 Lake Shawnee Dam Morris County, NJ		5. TYPE OF REPORT & PERIOD COVERED FINAL 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) JOHN J. WILLIAMS, P.E.		8. CONTRACT OR GRANT NUMBER(s) DACW61-80-D-0013 new
9. PERFORMING ORGANIZATION NAME AND ADDRESS O'Brien & Gere Engineers, Inc. Suite 1760 JFK Boulevard Phila. PA 19103		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS State and County Dam
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, Philadelphia Custom House, 2d & Chestnut Streets Philadelphia, Pennsylvania 19106		12. REPORT DATE September, 1980 13. NUMBER OF PAGES 80
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16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Copies are obtainable from National Technical Information Service, Springfield, Virginia, 22151.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dams	National Dam Safety Program, New Jersey	
Embankments	Lake Shawnee Dam	
Visual Inspection	Spillways	
Structural Analysis	Seepage	Riprap

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-N

24 SEP 1980

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Lake Shawnee Dam, Morris County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Lake Shawnee Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in poor overall condition. The dam's spillway is considered inadequate because a flow equivalent to 10 percent of the Spillway Design Flood - SDF- would cause the dam to be overtopped. (The SDF, in this instance, is one half of the Probable Maximum Flood.) To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Within three months of the consultant's findings, remedial measures to ensure spillway adequacy should be initiated.

b. Within 30 days from the date of approval of this report, the following remedial actions should be initiated:

(1) Investigations should be undertaken to verify the composition and condition of the embankment and the spillway section. Repairs to the spillway section should be effected in accordance with the findings of the investigations.

(2) The cause of the saturated areas at the downstream toe of the dam should be investigated. A method of seepage control should be designed if necessary.

(3) The trees should be removed from the embankment. Any remaining voids should be filled with suitable, thoroughly compacted material.

(4) The upstream face of the embankment should be backfilled where necessary with selected compacted material and provided with riprap to protect the slope from wave erosion. The riprap should extend from below the annual drawdown elevation to the top of the dam.

(5) Depressed portions of the crest of the embankment and the right abutment should be raised to the top of dam elevation with selected compacted material.

(6) The downstream face of the embankment should be backfilled where necessary with selected compacted material.

c. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam within one year from the date of approval of this report.

d. An emergency action plan should be developed which outlines actions to be taken by the owner to minimize the downstream effects of an emergency at the dam within thirty days from the date of approval of this report. This plan should include an effective warning system.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Courter of the Thirteenth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

NAPEN-N
Honcrable Brendan T. Byrne

An important aspect of the Dam Inspection Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

1 Incl
As stated

Copies furnished:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Regulation
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

LAKE SHAWNEE DAM (NJ00334)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 7 and 28 May and 19 June 1980 by O'Brien & Gere Engineers, Inc. under contract to the U.S. Army Engineer District, Philadelphia, in accordance with the National Dam Inspection Act, Public Law 92-367.

Lake Shawnee Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in poor overall condition. The dam's spillway is considered inadequate because a flow equivalent to 10 percent of the Spillway Design Flood - SDF- would cause the dam to be overtopped. (The SDF, in this instance, is one half of the Probable Maximum Flood.) To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Within three months of the consultant's findings, remedial measures to ensure spillway adequacy should be initiated.

b. Within 30 days from the date of approval of this report, the following remedial actions should be initiated:

(1) Investigations should be undertaken to verify the composition and condition of the embankment and the spillway section. Repairs to the spillway section should be effected in accordance with the findings of the investigations.

(2) The cause of the saturated areas at the downstream toe of the dam should be investigated. A method of seepage control should be designed if necessary.

(3) The trees should be removed from the embankment. Any remaining voids should be filled with suitable, thoroughly compacted material.

(4) The upstream face of the embankment should be backfilled where necessary with selected compacted material and provided with riprap to protect the slope from wave erosion. The riprap should extend from below the annual drawdown elevation to the top of the dam.

(5) Depressed portions of the crest of the embankment and the right abutment should be raised to the top of dam elevation with selected compacted material.

(6) The downstream face of the embankment should be backfilled where necessary with selected compacted material.

c. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam within one year from the date of approval of this report.

d. An emergency action plan should be developed which outlines actions to be taken by the owner to minimize the downstream effects of an emergency at the dam within thirty days from the date of approval of this report. This plan should include an effective warning system.

APPROVED: _____
JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 24 Sep 1980

(10) John J. Williams

DELAWARE RIVER BASIN

Name of Dam: Lake Shawnee Dam
County & State: Morris County, New Jersey
Inventory Number: NJ 00334

(12)

(9) Final repts.

(6) ~~PHASE I INSPECTION REPORT~~
NATIONAL DAM SAFETY PROGRAM. Lake Shawnee Dam (NJ 00334), Delaware River Basin, Weldon Brook, Morris County, New Jersey. Phase I Inspection Report.

Prepared by:

O'BRIEN & GERE ENGINEERS, INC. (11) A...

(15) DACW61-80-D-0013

For

DEPARTMENT OF THE ARMY
Philadelphia District, Corps of Engineers
Custom House - 2nd & Chestnut Streets
Philadelphia, Pennsylvania 19106

AUGUST 1980

410760 slk

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and anlayses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data availabe to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT

NATIONAL DAM INSPECTION REPORT

Name of Dam:	Lake Shawnee (Duck Pond Dam) ID # NJ 00334
State Located:	New Jersey
County Located:	Morris
Stream:	Weldon Brook
Coordinates:	Latitude 40°58.2', Longitude 74°35.9'
Dates of Inspection:	May 7, May 28, and June 19, 1980

ASSESSMENT

Based on visual observations made during the inspections, information provided by the New Jersey Department of Environmental Protection (NJDEP), and conversations with the Owner's representatives, Lake Shawnee Dam (owned by the Lake Shawnee Club) is considered to be in poor overall condition.

The dam is an earth embankment approximately 150 feet in length with a maximum height of about 9 feet. A concrete overflow spillway with a crest length of 50 feet is located at the right abutment. Two saturated areas were observed at the downstream toe of the embankment, apparently resulting from seepage through the embankment or foundation. Several trees are growing from the surface of the embankment and the upstream slope is unprotected from wave erosion. The spillway section, abutment walls and downstream apron appear to be in deteriorated condition and water is flowing through cracks in the spillway.

The selected Spillway Design Flood (SDF) for this "Small" size, "Significant" hazard dam is one-half of the Probable Maximum Flood (PMF). Examination of the results of the hydrologic and hydraulic analyses indicates that the spillway is capable of discharging approximately 9 percent of the SDF (4.5 percent of the PMF) prior to overtopping of the embankment. Therefore, the spillway is classified as "Inadequate".

Recommendations and remedial measures which should be initiated immediately are as follows:

a. Facilities

1. Investigations should be undertaken to verify the composition and condition of the embankment and the spillway section. Repairs to the spillway section should be effected in accordance with the findings of the investigations.

2. Detailed hydrologic and hydraulic analyses should be performed to determine the need for and type of mitigating measures required to ensure spillway adequacy.

3. The cause of the saturated areas at the downstream toe of the dam should be investigated. A method of seepage control should be designed if necessary.

4. The trees should be removed from the embankment. Any remaining voids should be filled with suitable, thoroughly compacted material.

5. The upstream face of the embankment should be backfilled where necessary with selected compacted material and provided with riprap to protect the slope from wave erosion. The riprap should extend from below the annual drawdown elevation to the top of the dam.

6. Depressed portions of the crest of the embankment and the right abutment should be raised to the top of dam elevation with selected compacted material.

7. The downstream face of the embankment should be backfilled where necessary with selected compacted material.

b. Operation and Maintenance

1. The Owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

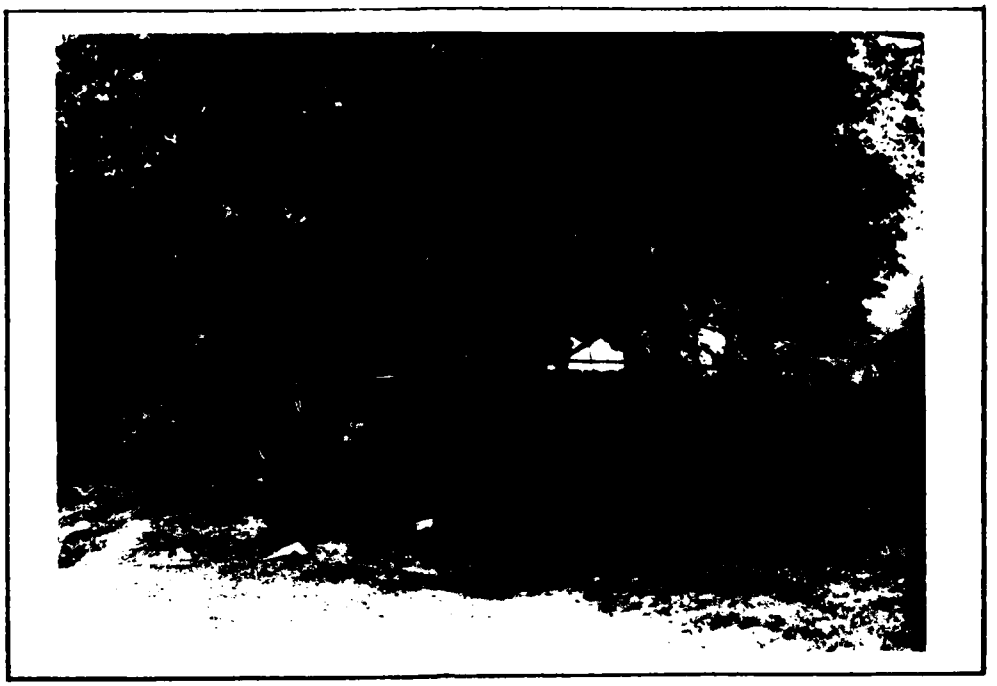
2. An emergency action plan should be developed which outlines actions to be taken by the Owner to minimize the downstream effects of an emergency. This plan should include an effective warning system.

O'BRIEN & GERE ENGINERS, INC.

John J. Williams

John J. Williams, P.E.
Vice President
New Jersey Registration No. 24916

Date: 28 Aug. 80



DOWNSTREAM OVERVIEW OF LAKE SHAWNEE DAM AS OBSERVED FROM THE LEFT ABUTMENT. (5/28/80)

UPSTREAM OVERVIEW OF LAKE SHAWNEE DAM AS OBSERVED FROM THE RIGHT ABUTMENT. (5/28/80)

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(Continued)

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM
LAKE SHAWNEE DAM
INVENTORY NUMBER - NJ 00334

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority. This report is authorized by the Dam Inspection Act, Public Law 92-367, and has been prepared in accordance with contract #DACW61-80-D-0013 between O'Brien & Gere Engineers, Inc. and the United States Army Corps of Engineers, Philadelphia District.

b. Purpose of Inspection. The purpose of the inspection is to evaluate the structural and hydraulic condition of Lake Shawnee Dam and appurtenant structures and to determine if the dam constitutes a hazard to human life or property.

1.2 Project Description (Based on information provided by the New Jersey Department of Environmental Protection (NJDEP) and supplemented by field observations.)

a. Description of Dam and Appurtenances. Lake Shawnee Dam is an earth embankment approximately 150 feet long (including spillway) with a maximum height of about 9 feet. The top of the dam is irregular and averages about 11 feet in width. The upstream face of the embankment is variable with the visible portion on a slope which is flatter than 5H:1V. The downstream face of the dam is on a slope of approximately 2.5H:1V at the maximum section and gradually flattens to 10H:1V at the left abutment.

The spillway, which is located at the right abutment, is a slightly-arched (in the upstream direction) concrete overflow section with a 7-foot height and a crest length of 50 feet. There is 2.2 feet of freeboard available between the spillway crest and the top of the dam. A wire fence trash screen extends about one foot above the spillway crest elevation about 5 feet upstream of the spillway. Masonry cutoff walls extend approximately 20 feet from either side of the spillway sidewalls, into the embankment on the left side of the spillway and into the abutment on the right side.

An intake structure is located along the upstream face of the dam approximately 20 feet from the left abutment. A rising stem gate valve located in the intake structure controls flow into a 36-inch diameter cast iron pipe which connects to a 48-inch diameter corrugated metal pipe within the embankment. Flow discharges from the 48-inch pipe at the downstream toe of the embankment.

b. Location. Lake Shawnee Dam is located on Weldon Brook in Hurdtown, New Jersey. The dam is approximately 400 feet east of New Jersey Route 15 and about one-half of a mile to the east of Lake Hopatcong. The site is shown on the USGS Quadrangle entitled "Dover, N.J." at coordinates N 40° 58.2', W 74° 35.9'. A regional location map of Lake Shawnee Dam is included as Figure 1 in Appendix E.

c. Size Classification. Lake Shawnee Dam has a maximum height of about 9 feet which places it in the "Small" size dam category for height since it is less than 40 feet high. The maximum storage capacity of 376 acre-feet also places the dam in the "Small" size classification for storage (less than 1,000 acre-feet). Therefore, Lake Shawnee Dam is classified as a "Small" size structure.

d. Hazard Classification. Weldon Brook flows through 4 highway culverts and into an eastern extension of Lake Hopatcong approximately 1,000 feet downstream of Lake Shawnee Dam. The first culvert is located approximately 150 feet downstream of the dam and is a triple-arch (arches about 8 feet high) culvert beneath a masonry bridge which supports a local road around the lake. The elevation of the top of this bridge is above the top of dam elevation. The second culvert is located about 250 feet downstream of the dam and is a 25-foot wide by 5-foot high concrete box culvert beneath an exit ramp bridge for N.J. State Route 15. The third and fourth culverts are less than 50 feet apart, located about 400 feet downstream of the dam. These culverts are 35-foot wide by 6-foot high concrete box culverts beneath the northbound and southbound lanes, respectively, of Route 15. The nearest downstream residences are located on an island in this eastern extension of Lake Hopatcong, approximately 2,000 feet downstream of the dam. The lake at this location is approximately 1,200 feet wide and a breach flood from Lake Shawnee Dam would cause an increase of less than a foot in the existing water surface elevation. This assessment is based on the relatively small storage capacity of Lake Shawnee, the flood attenuating effects of the 4 highway culverts and Lake Hopatcong, and the width of the flood plain between Lake Shawnee and Lake Hopatcong. The sill elevations of the lowest houses on the shores of Lake Hopatcong would still be more than one foot above the surface of the water in Lake Hopatcong. Therefore, loss of life would be unlikely in the event of a breach flood, although some property damage could occur to the residences. The highway embankments adjacent to the three culverts located furthest downstream could be subjected to appreciable damage in the event of a breach flood. However, it is unlikely that any of the highways would be overtopped. A structure owned by the Sparta Mountain Water Company is located about 50 feet downstream near the left abutment and could also experience appreciable property damage. Therefore, Lake Shawnee Dam is classified in the "Significant" hazard potential category.

e. Ownership. Lake Shawnee Dam is owned by the Lake Shawnee Club, 4 West Shawnee Trail, Wharton, New Jersey, 07885. The Lake Shawnee Club was founded in 1946. According to a 1922 inspection report, the Owner of the dam (then known as Duck Pond Dam) at that time was Jerome Brady of Wharton, N.J.

f. Purpose of Dam. According to the 1922 inspection report, the original purpose of the dam was to impound a reservoir for ice harvesting. Lake Shawnee is currently used for recreational purposes by the Lake Shawnee Club members and for water supply by the Sparta Mountain Water Company.

g. Design and Construction History. No information is available concerning the original design and construction of the dam. However, it is known that the dam was constructed prior to 1922.

h. Normal Operating Procedures. Correspondence records for Lake Shawnee Dam indicate that the lake was periodically drawn down between 1966 and 1976 for the purpose of cleaning and repairing docks and for removing weeds. No records are available for any other operating procedures.

1.3 Pertinent Data

a. Drainage Area.

Square Miles	7.6

b. Discharge at Dam Site (cfs).

Spillway Capacity	522

c. Elevation (Feet above NGVD).

Spillway Crest (Normal Pool)	935.0
Top of Dam (Maximum Pool)	937.2
Streambed at Downstream Toe of Dam	928.0
Outlet Conduit Invert	930.0
Tailwater	928.5

d. Reservoir Length (Feet).

Normal Pool	4,800
Maximum Pool	4,830

e. Storage (Acre-Feet).

Normal Pool	184
Maximum Pool	376

f. Reservoir Surface Area (Acres)

Normal Pool	79
Maximum Pool	98

g. Dam Data.

Type	Earth
Length	150 Feet (including spillway)
Height	9 Feet
Top Width	11 Feet
Side Slopes (Upstream)	Variable, Flatter than 5H:1V
(Downstream)	Variable, 2.5H:1V to 10H:1V
Zoning	Unknown
Impervious Core	Unknown
Cutoff	Unknown
Grout Curtain	Unknown

h. Spillway.

Type	Concrete/Masonry Overflow
Crest Length	50 Feet
Crest Elevation	935.0
Gates	None
Upstream Channel	Lake Shawnee
Downstream Channel	Weldon Brook

i. Outlet Works. The outlet works consist of a 3-foot diameter cast iron pipe connected to a 4-foot diameter corrugated steel reservoir drain pipe controlled by a rising stem gate valve located approximately 70 feet left of the spillway along the upstream face of the dam.

SECTION 2

ENGINEERING DATA

2.1 Design

a. Data Available. Information available from the New Jersey Department of Environmental Protection (NJDEP) consists of correspondence records from 1966 to the present and previous inspection reports (1922, 1971, 1977). No design data or drawings are available for this structure.

b. Design Features. The principal design features for this structure are discussed in Section 1.2a.

2.2 Construction

No information relative to the original construction of Lake Shawnee Dam is available. The earliest report indicates that the dam was constructed prior to 1922.

2.3 Operation

The correspondence records indicate that the reservoir was periodically drawn down between 1966 and 1976 for the purpose of cleaning and repairing docks and for the removal of weeds. No other operational data is available.

2.4 Evaluation

a. Availability. All information made available was provided by the NJDEP. No original design or construction information is available.

b. Adequacy. The information made available by NJDEP, conversations with the Owner's representatives, and observations made during the field investigations provided adequate data for a Phase I evaluation.

c. Validity. There appears to be no reason to question the validity of the data provided by the NJDEP.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. The original field inspections of Lake Shawnee Dam took place on May 7 and May 28, 1980. The photographs which appear in this report were taken on May 28, 1980. At the time of these inspections, the reservoir water surface was approximately one inch above the spillway crest elevation. A third field inspection took place on June 19, 1980, several days after the reservoir drain sluice gate had broken and the lake level had dropped by approximately one foot. The gate had been replaced but the lake level had been drawn down to approximately 3 inches below the spillway crest at the time of the inspection. No underwater areas were inspected. The observations and comments of the field inspection team are in the checklist which is Appendix B of this report. The appearance of the facility indicates that the dam and its appurtenances are marginally maintained.

b. Dam. Lake Shawnee Dam is a poorly-defined earth embankment with undulating and eroded surfaces on both the upstream and downstream faces of the dam. The crest is variable in width and portions of the crest are depressed such that only about a one-foot wide strip of the crest is actually at the top of dam elevation. The upstream slope is protected by small stone riprap near the left abutment, but the majority of the upstream face is unprotected. A number of trees (trunks up to 12 inches in diameter and 30 feet high) and bushes were observed growing from the face of the embankment on the dates of the inspections. Several stumps (most about 6 inches in diameter) were noted at the downstream toe of the dam which indicates that some trees have recently been removed. During the inspections, two saturated areas (each about 10 feet in diameter) were observed at the downstream toe about 50 feet to the left of the spillway. The ground is extremely soft in this location. The saturated areas appear to be the result of seepage (about 5 gpm) through the embankment or foundation.

c. Appurtenant Structures. The spillway section was partially obscured by the overflowing water during the first two inspections, but was clearly visible during the third inspection. The spillway and abutments appear to consist of stone blocks with a concrete facing. The concrete has severely deteriorated, exposing the stone interior in several locations. Water was observed seeping through the spillway section in several of the cracked and eroded areas. In addition, the spillway abutments are severely cracked and spalled and a small amount of seepage (less than 1 gpm) was observed flowing from the vicinity of the abutments. A concrete apron at the downstream toe of the spillway is undermined and sections of the apron have broken off. At the time of the inspections, the wire fence trash screen had accumulated some debris.

A new reservoir drain sluice gate had been installed several days prior to the third field inspection. During the inspection, the gate was partially open to maintain the reservoir level below the spillway crest elevation.

d. Reservoir Area. Sediment deposits were evident in the vicinity of the spillway on the dates of the inspections but the overall extent of the sedimentation could not be determined. The reservoir side slopes are extremely flat in the vicinity of the dam and range up to nearly 30 percent at the upstream end of the lake. The entire perimeter of the lake is extensively developed in residential housing. The banks are covered with vegetation ranging from lawn areas to trees up to 50 feet high.

e. Downstream Channel. The downstream channel is Weldon Brook, a natural earth channel on a slope of less than one percent, which discharges into an eastern extremity of Lake Hopatcong approximately 1,000 feet downstream of the dam. The channel passes through a triple arch highway culvert (about 150 feet downstream), a rectangular highway culvert (about 250 feet downstream), and two successive rectangular culverts beneath State Route 15 (about 400 feet downstream) prior to discharging into the eastern extension of Lake Hopatcong. The culvert dimensions are described in Section 1.2d. The nearest residential hazard area is a group of approximately 20 houses located 2,000 to 3,000 feet downstream of Lake Shawnee Dam on an island in the eastern extension of Lake Hopatcong.

SECTION 4

OPERATIONAL FEATURES

4.1 Procedures

The Owner's representatives during the first inspection, Mrs. Philip McConnell and Mrs. James Watson (two board members of the Lake Shawnee Club), stated that the reservoir is generally drawn down about 3 feet in October of every year, for cleaning and repairing the docks. The gate valve became inoperable during 1979 and the reservoir was not drawn down between October of 1978 and June of 1980. The sluice gate cracked in June of 1980 and the reservoir level lowered by about one foot.

4.2 Maintenance of the Dam

According to the Owner's representatives, no regular maintenance program (other than occasional cutting of the grass) currently exists for Lake Shawnee Dam. However, several trees (trunks averaging about 6 inches in diameter) which had been growing from the downstream toe of the embankment have recently been cut down.

4.3 Maintenance of Operating Facilities

According to the Owner's representatives, the gate valve was operated annually until October of 1978. A new sluice gate was installed in June of 1980 to replace the original one which cracked. According to Mr. Frank Meisner, the Owner's representative during the third inspection, the gate guides will also be repaired.

4.4 Description of any Warning System in Effect

According to the Owner's representatives, no warning systems are in effect at this site.

4.5 Evaluation of Operational Adequacy

A regular inspection and maintenance program should be developed and implemented by the Owner. The maintenance program should include periodic operation of the sluice gate valve to verify operability.

A downstream warning system should be developed. The dam should be monitored during periods of heavy rainfall, and downstream residents and highway authorities should be alerted in the event of an impending failure.

SECTION 5

HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features

a. Design Data. No hydrologic or hydraulic design data was available with the information provided by the New Jersey Department of Environmental Protection (NJDEP). Lake Shawnee has a drainage area of 7.6 square miles and the spillway has an estimated discharge capacity of 522 cfs.

For further information, refer to the calculations and computer printout included in Appendix C of this report.

b. Experience Data. No rainfall or reservoir level records are known to be maintained for this dam. According to Mr. Meisner, the dam was overtopped by hurricane flooding around 1970. According to the Owner's representatives, the impoundment can be drawn down about 3 feet in 7 to 10 days. They believe the impoundment can be drawn down a maximum of 5 feet below normal pool leaving a minimum of 2 feet of water in the lake.

c. Visual Observations. On the dates of the inspections, the wire fence trash screen located about 5 feet upstream of the spillway had accumulated some debris. Further accumulation of this debris could result in obstruction of spillway overflow.

d. Overtopping Potential. The recommended Spillway Design Flood (SDF) range for a "Small" size, "Significant" hazard dam is from the 100-year flood to one-half of the Probable Maximum Flood (PMF). Due to the potential for damage to the downstream highway embankments, the selected SDF is one-half of the PMF. The SDF was synthesized from one-half of the Probable Maximum Precipitation (PMP) using the SCS unit hydrograph. The SDF hydrograph was routed through the reservoir with the initial water surface elevation at the spillway crest. The peak inflow and outflow rates for the SDF were computed to be 12,131 cfs and 12,028 cfs, respectively. The spillway is capable of discharging approximately 9 percent of the SDF prior to overtopping of the embankment (refer to Appendix C for computations and the computer printout).

e. Spillway Adequacy. The spillway is considered inadequate since it is incapable of discharging the SDF.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. The saturated areas at the downstream toe of the embankment indicate that seepage is occurring through or beneath the embankment which could cause structural damage to the dam. Trees growing from the embankment create potential seepage paths along their root systems which may be contributing to the existing seepage. The trees also present a hazard to the structural integrity of the dam since significant portions of the embankment would be removed if the trees were uprooted during severe wind conditions. In addition, the majority of the upstream face of the dam is unprotected from wave erosion.

The concrete on the spillway section and side walls appears to be in poor condition. Continued deterioration of these concrete sections could lead to failure of the spillway.

b. Design and Construction Data. No design or construction data is available for Lake Shawnee Dam.

c. Operating Records. According to the Owner's representatives, the reservoir was partially drawn down in October of every year through 1978. Correspondence records provided by the New Jersey Department of Environmental Protection (NJDEP) indicate that permission was granted by the Bureau of Water Control for the annual drawdowns between 1966 and 1976.

d. Post Construction Changes. No modifications to the original structure have been recorded. A new sluice gate was installed in June of 1980 to replace the original gate which had recently cracked.

e. Seismic Stability. Lake Shawnee Dam is located in Seismic Zone 1 on the "Seismic Zone Map of Contiguous States". A dam located in Seismic Zone 1 is generally considered to be safe under expected Zone 1 earthquake loading conditions if it is stable under static loading conditions. The embankment appears to be structurally stable, although seepage could reduce the stability. The spillway section appears to have some stability problems and repairs are recommended.

SECTION 7

ASSESSMENT, RECOMMENDATIONS AND PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment

a. Safety. The visual observations and review of available information indicate that Lake Shawnee Dam is in poor condition. The deficiencies and problem areas noted in Section 6.1a are indicative of a general lack of maintenance and potentially hazardous structural conditions.

The selected Spillway Design Flood (SDF) for this site is 50 percent of the Probable Maximum Flood (PMF). The spillway is capable of discharging approximately 9 percent of the SDF prior to overtopping of the embankment. Therefore, the spillway is classified as "Inadequate".

b. Adequacy of Information. The information provided by the New Jersey Department of Environmental Protection (NJDEP), conversations with the Owner's representatives and observations made during the field investigations provided adequa te data for a Phase I evaluation.

c. Urgency. The recommendations and remedial measures described in Section 7.2 should be initiated immediately.

d. Necessity for Further Investigation. Further investigations should be performed in accordance with Section 7.2a, Items 1, 2, and 3.

7.2 Recommendations and Proposed Remedial Measures

a. Facilities

1. Investigations should be undertaken to verify the composition and condition of the embankment and the spillway section. Repairs to the spillway section should be effected in accordance with the findings of the investigations.

2. Detailed hydrologic and hydraulic analyses should be performed to determine the need for and type of mitigating measures required to ensure spillway adequacy.

3. The cause of the saturated areas at the downstream toe of the dam should be investigated. A method of seepage control should be designed if necessary.

4. The trees should be removed from the embankment. Any remaining voids should be filled with suitable, thoroughly compacted material.

5. The upstream face of the embankment should be backfilled where necessary with selected compacted material and provided with riprap to protect the slope from wave erosion. The riprap should extend from below the annual drawdown elevation to the top of the dam.

6. Depressed portions of the crest of the embankment and the right abutment should be raised to the top of dam elevation with selected compacted material.

7. The downstream face of the embankment should be backfilled where necessary with selected compacted material.

b. Operation and Maintenance Procedures

1. The Owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

2. An emergency action plan should be developed which outlines actions to be taken by the Owner to minimize the downstream effects of an emergency. This plan should include an effective warning system.

APPENDIX

A

Check List Engineering Data

Design, Construction, Operation

Phase I

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Shawnee Lake Dam
(Duck Pond Dam)
ID # NJ 00334

ITEM	REMARKS
AS-BUILT DRAWINGS	None available
REGIONAL VICINITY MAP	Refer to Figure 1 in Appendix E
CONSTRUCTION HISTORY	No information is available concerning the original construction of the dam. However, it is known that the dam was constructed prior to 1922.
TYPICAL SECTIONS OF DAM	Refer to Sheet 3 in Appendix E
OUTLETS - PLAN	Refer to Sheet 4 in Appendix E
DETAILS	
CONSTRAINTS	
DISCHARGE RATINGS	None available
RAINFALL/RESERVOIR RECORDS	None available

ITEM	REMARKS
DESIGN REPORTS	None available
GEOLOGY REPORTS	None provided. Refer to Appendix F of this report.
DESIGN COMPUTATIONS	No data available
HYDROLOGY & HYDRAULICS	No data available
DAM STABILITY	No data available
SEEPAGE STUDIES	No data available
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	No information available
POST-CONSTRUCTION SURVEYS OF DAM	None available
BORROW SOURCES	There is no record of the source of the borrow material.

ITEM	REMARKS
MONITORING SYSTEMS	None
MODIFICATIONS	None noted
HIGH POOL RECORDS	Since 1965, the maximum reservoir level was about 1.5 feet above the spillway crest (0.7 ft below the top of the dam).
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None known
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None reported
MAINTENANCE OPERATION RECORDS	None available

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	Refer to Sheets 2 and 3 in Appendix E
OPERATING EQUIPMENT PLANS & DETAILS	None available
MISCELLANEOUS	No engineering data or drawings are available for this site. Material in Appendix E was developed for this report.

APPENDIX

B

Check List

Visual Inspection

Phase I

CHECK LIST
VISUAL INSPECTION
PHASE I

Name Dam Shawnee Lake Dam (Duck Pond Dam) County Morris State New Jersey National ID # NJ 00334

Type of Dam Earth with Concrete Spillway Hazard Category Significant

Date(s) Inspection May 7, 1980 / May 28, 1980 Weather Clear / Clear Temperature 70° F / 70° F

Pool Elevation at Time of Inspection 935.1 ± M.S.L. Tailwater at Time of Inspection 928.5 ± M.S.L.

Inspection Personnel:

Lee DeHeer
Robert Bowers
Paul Pettit

Robert Bowers Recorder

Remarks:

Mrs. Philip McConnell and Mrs. James Watson of the Lake Shawnee Club, and Mr. James Kearns and Mr. Larry Lindgren of the NJDEP were present during the inspection.

CONCRETE/MASONRY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	A small amount of seepage (less than 1 gpm) was observed flowing from the vicinity of the spillway sidewalls.	Draw down the reservoir to investigate the cause of seepage here and in the embankment portion of the dam.
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Concrete spillway sidewalls higher than crest of dam.	Embankment crest should be raised to at least the level of the sidewalls of the spillway with selected compacted material.
DRAINS	None Observed	
WATER PASSAGES	Weir overflow only	
FOUNDATION	Material unknown	

CONCRETE/MASONRY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Many surface cracks on the concrete portion of the spillway.	Epoxy coat the cracked surfaces.
STRUCTURAL CRACKING	Concrete in the spillway sidewalls is severely cracked. Several large cracks were visible even through the discharge in the masonry headwall of the spillway.	Draw down the reservoir to allow for repairs of both the sidewalls and the headwall. Replace concrete and masonry as needed.
VERTICAL AND HORIZONTAL ALIGNMENT	Vertical and horizontal alignment appeared satisfactory.	
MONOLITH JOINTS	None Observed	
CONSTRUCTION JOINTS	None Observed	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	*None observed*	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Both the upstream and downstream faces of the embankment are eroded and undulated. The crest is variable in width and its elevation is both variable and below the level of the spillway sidewalls.	Both the upstream and downstream faces of the embankment should be back filled where necessary with selected compacted material. The crest of the embankment should be raised to at least the level of the sidewalls of the spillway with selected compacted material.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Both the vertical and horizontal alignment of the crest are poorly defined.	Refer to recommendations for sloughing or erosion of embankment and abutment slopes.
RIPRAP FAILURES	No evidence of riprap failure as such. Token cobble size riprap near the left abutment while the rest of the upstream slope is unprotected.	Riprap of suitable size should be placed on the upstream face of the dam for protection against wave action.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Poorly defined junction of the embankment and abutment. Embankment, spillway junction is poor with the spillway sidewalls higher than the embankment crest.	Refer to recommendations for sloughing or erosion of embankment and abutment slopes.
ANY NOTICEABLE SEEPAGE	Seepage areas observed along the downstream toe of the embankment (5 gpm) and through the spillway sidewalls (1 gpm).	The cause of the seepage should be investigated and a seepage control system should be designed if it is considered necessary.
STAFF GAGE AND RECORDER	None	
DRAINS	None Observed	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Not applicable. Outlet conduit is corrugated steel pipe (48-inch diameter)	
INTAKE STRUCTURE	Concrete appears satisfactory. No trash rack observed.	Recommend trash rack to keep materials from clogging outlet works.
OUTLET STRUCTURE	None	
OUTLET CHANNEL	Weldon Brook channel. No appreciable obstructions.	
EMERGENCY GATE	Inoperable	Repair to allow for draw down of the reservoir.

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None Observed	
OBSERVATION WELLS	None Observed	
WEIRS	None Observed	
PIEZOMETERS	None Observed	
OTHER	None	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	The reservoir side slopes are extremely flat in the vicinity of the dam and range up to nearly 30 percent at the upstream end of the lake.	
SEDIMENTATION	Sediment deposits are in evidence in the vicinity of the spillway, but the overall extent of the sedimentation could not be determined.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	The downstream channel is Weldon Brook which discharges into an eastern extremity of Lake Hopatcong approximately 1,000 ft. downstream of the dam. The channel passes through a triple arch bridge (about 100 ft downstream), a rectangular highway bridge (about 300 ft downstream, and two rectangular bridges beneath state route 15(about 400 ft downstream). Other than the bridges there is no significant obstruction to the downstream channel.	
SLOPES	The channel is on a gradient of about 0.1 percent The banks which are covered with vegetation are on slopes ranging from about 1.5:1 to 5:1 (H:V)	
APPROXIMATE NO. OF HOMES AND POPULATION	The nearest residential hazard area is a group of approximately 20 houses with an estimated 100 people located 2,000 to 3,000 ft downstream of Lake Shawnee Dam on an island in the eastern extension of Lake Hopatcong.	An emergency action plan should be developed which outlines actions to be taken by the Owner to minimize the downstream effects of an emergency. This plan should include an effective warning system.

APPENDIX

C

Hydrologic & Hydraulic Data

O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
Lake Shawnee Dam, Phase I, ODEQ Engr				

APPENDIX C
HYDROLOGIC & HYDRAULIC DATA
TABLE OF CONTENTS

O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
LAKE SHAWNEE DAM (Duck Rd. Dam)	1	RRB	5/14/80	1800-006-103

HYDROLOGY CALCULATIONS

DRAINAGE AREA (PLANIMETERED FROM USGS QUAD SHEETS): 7.6 SQUARE MILES

PMP CALCULATIONS (HMR 33)

AREA IS IN ZONE 6

24 HR., 200 SQ. MI. RAINFALL = 22.5 INCHES

6 HR. % FOR 7.6 MI.^{2} RAINFALL = 113
12 HR. % " " " " = 123
24 HR. % " " " " = 132
48 HR. % " " " " = 142

UNIT HYDROGRAPH LAG TIME

USE SCS UNIT HYDROGRAPH - UPLAND METHOD

$T = L/V$ WHERE $V = \frac{1.49}{n} R^{2/3} S^{1/2}$ (FOR CHANNEL FLOW)

SEVERAL STREAM PATH FLOWS WERE COMPUTED AND THE MAXIMUM LAG TIME WAS USED.

O'BRIEN & GERE

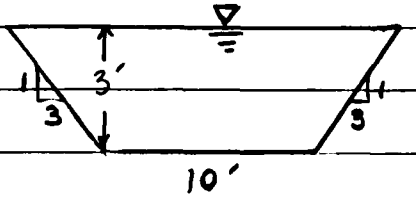
SUBJECT	SHEET	BY	DATE	JOB NO
LAKE SHAWNEE DAM (Duck Pd. Dam)	2	RRB	5/16/86	1800-006-103

1. NORTHWEST PATH (WELDON BROOK)

CHANNEL FLOW : $L = 16{,}000$ FEET, $S = 280\ \text{FT.} / 16{,}000\ \text{FT.} = .018$ OR 1.8 %

$$V = \frac{1.49}{n} R^{2/3} S^{1/2}$$

ASSUMED CHANNEL DIMENSIONS →



$$R = \frac{57\ \text{FT.}^2}{29.0\ \text{FT.}} = 1.97\ \text{FT.}$$

$n = .08$

$$V = \frac{1.49}{.08} (1.97)^{2/3} (.018)^{1/2} = 3.9\ \text{FT./SEC.}$$

$$T = L/V = 16{,}000/3.9 = 4100\ \text{SEC.} = \underline{1.14\ \text{HOURS}}$$

2. NORTHEAST PATH (BEAVER BROOK)

OVERLAND FLOW : $L = 2{,}000$ FT., $S = .065$ OR 6.5 %

FROM SCS NOMOGRAPH (P. 15-8, HYDROLOGY SECTION 5), FOR A WOODLAND CONDITION,

$V \cong 1.3$ FT./SEC.

$$T_1 = L/V = 2{,}000/1.3 = 1540\ \text{SEC.} = \underline{0.43\ \text{HOURS}}$$

CHANNEL FLOW : $L = 18{,}000$ FT., $S = 290/18{,}000 = .016$ OR 1.6 %

O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
LAKE SHAWNEE DAM (Dick Pd. Dam)	3	RRB	5/14/80	1800-006-103

ASSUMING A CHANNEL SIMILAR TO THE NORTHWEST PATH CHANNEL, BUT WITH n = .04 AND WIDTH OF 15 FEET,

$$V = \frac{1.49}{.04}(2.12)^{2/3}(.016)^{1/2} = 7.8 \text{ FT./SEC.}$$

$$T_2 = 18{,}000 \text{ FT.} / 7.8 \text{ FT/SEC} = 2{,}310 \text{ SEC.} = \underline{0.64 \text{ HRS.}}$$

$$T = T_1 + T_2 = \underline{1.07 \text{ HRS.}}$$

3. EAST PATH

OVERLAND FLOW: L = 5,000 FT., S = .018 OR 1.8 %

FROM SCS NOMOGRAPH FOR WOODLAND CONDITION, V ≅ 0.7 FT./SEC.

$$T_1 = L/V = 5{,}000/0.7 = 7{,}140 \text{ SEC.} = \underline{2.0 \text{ HRS.}}$$

CHANNEL FLOW: L = 10,000 FT., S = 130/10,000 = .013 OR 1.3 %

$$V = \frac{1.49}{.04}(2.12)^{2/3}(.013)^{1/2} = 7.0 \text{ FT./SEC.}$$

$$T_2 = L/V = 10{,}000/7.0 = 1{,}430 \text{ SEC.} = \underline{0.4 \text{ HRS.}}$$

$$T = T_1 + T_2 = \underline{2.4 \text{ HRS.}}$$

LAG TIME $L = 0.6\,T = 0.6(2.4) \cong$ **1.5 HOURS**

O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
LAKE SHAWNEE DAM (DUCK POND DAM)	3A	RRB	5/14/80	1800-006-103

OTHER LAG TIME METHODS

SCS CURVE NUMBER METHOD:

$$L = \frac{\ell^{0.8}(S+1)^{0.7}}{1900\, Y^{0.5}}$$

ℓ = HYD. LENGTH OF WATERSHED IN FEET = 20,000 FT.

$S = \frac{1000}{CN} - 10 = \frac{1000}{70} - 10 = 4.29$

Y = AVG. WATERSHED SLOPE IN % $= \frac{1360-940}{20,000} = 2.1\%$

$$L = \frac{20,000^{0.8}(4.29+1)^{0.7}}{1900\,(2.1)^{0.5}} = \boxed{3.2 \text{ HOURS}}$$

CALIFORNIA HIGHWAYS METHOD:

$$T = \left(\frac{11.9\,L^3}{H}\right)^{0.385} = \left(\frac{11.9(3.8 \text{ MILES})^3}{420 \text{ FT}}\right)^{0.385}$$

$T = 1.2$ HRS., $L = 0.6\,(1.2) \cong \boxed{0.7 \text{ HOURS}}$

NAVDOCKS METHOD:

FOR 2.1% SLOPE, AVG. $V = 3$ FT/SEC.

$T_c = L/V = 20,000 \text{ FT.} / 3 \text{ FT./SEC.} = 6670$ SEC.

$T_c = 1.9$ HRS., $L = 0.6\,T_c = \boxed{1.1 \text{ HRS.}}$

SCS UPLAND METHOD IS MOST REPRESENTATIVE, USE $\boxed{L = 1.5 \text{ HOURS}}$

O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
LAKE SHAWNEE DAM (Dirt Pd. Dam)	4	RRB	5/14/80	1800-006-103

RESERVOIR SURFACE AREAS

ELEV.	SURF. AREA	STORAGE (COMPUTED BY HEC-1 PROGRAM)
928	0 ACRES	0 ACRE-FEET
935 (NORMAL POOL - EST. FROM USGS)	79 ACRES	184 ACRE-FEET
940	118 ACRES	673 ACRE-FEET
960	258 ACRES	4,343 ACRE-FEET

DISCHARGE CALCULATIONS

SPILLWAY DISCHARGE → $Q_S = CLH_S^{3/2}$ WHERE $C \approx 3.2$, $L = 50$ FT.

SPILLWAY CAPACITY PRIOR TO OVERTOPPING → $H = 2.2$ FT., $Q = 522$ CFS

DAM OVERFLOW DISCHARGE → $Q_D = CLH_D^{3/2}$ WHERE $C \approx 3.0$, $L \approx 150$ FEET.

IN ADDITION, THE RESERVOIR WILL OVERFLOW THE WATERSHED BOUNDARY ALONG BOTH ENDS OF THE DAM → $Q_W = CLH_W^{3/2}$ WHERE $C \approx 2.8$ AND L VARIES.

RESERVOIR SURF. ELEV.	H_S (FT.)	Q_S (CFS)	H_D (FT.)	Q_D (CFS)	H_W (FT)	$L_{W\,EFF.}$ (FT.)	Q_W (CFS)	Q_{TOTAL} (CFS)
935	0	0	—	—	—	—	—	0
936	1	160	—	—	—	—	—	160
937.2	2.2	522	0	0	0	0	0	522
938	3	831	0.8	322	0.8	140	280	1,433
940	5	1,789	2.8	2,108	2.8	500	6,559	10,456
945	10	5,060	7.8	9,803	7.8	650	39,647	54,510

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********
    1          A1                        NATIONAL DAM INSPECTION PROGRAM
    2          A2                          LAKE SHAWNEE (DUCK POND) DAM
    3          A3                              HYDROLOGIC ANALYSIS
    4          B    300       0      15       0       0       0       0       0      -3       0
    5          B1     5
    6          J      1       9       1
    7          J1   .05     .10     .15     .20     .25     .30     .50     .75    1.0
    8          K      0  INFLOW                                      1
    9          K1                              INFLOW TO LAKE SHAWNEE
   10          M      1       2     7.6                                                    1
   11          P      0    22.5     113     123     132     142
   12          T                                                   1.0     .05
   13          W2           1.5
   14          X   -1.5    -.05       2
   15          K      1  OUTFLO                                      1
   16          K1                            OUTFLOW FROM LAKE SHAWNEE DAM
   17          Y                                       1       1
   18          Y1     1                                                -935      -1
   19          Y4   935     936   937.2     938     940     945
   20          Y5     0     160     522    1433   10456   54510
   21          $A     0      79     118     258
   22          $E   928     935     940     960
   23          $S   935
   24          $D 937.2
   25          K     99


                                PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

                                RUNOFF HYDROGRAPH AT      INFLOW
                                ROUTE HYDROGRAPH TO       OUTFLO
                                END OF NETWORK
```

Sh 5

FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79

RUN DATE= 05/22/80.
TIME= 12.13.12.

NATIONAL DAM INSPECTION PROGRAM
LAKE SHAWNEE (DUCK POND) DAM
HYDROLOGIC ANALYSIS

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	15	0	0	0	0	0	-3	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 9 LRTIO= 1

RTIOS= .05 .10 .15 .20 .25 .30 .50 .75 1.00

SUB-AREA RUNOFF COMPUTATION

INFLOW TO LAKE SHAWNEE

	ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
INFLOW		0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	7.60	0.00	7.60	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.50	113.00	123.00	132.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TC= 0.00 LAG= 1.50

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 32 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= 1.50 VOL= 1.00

153.	450.	923.	1546.	2024.	2241.	2241.	2052.	1790.	1432.
1056.	818.	632.	506.	395.	304.	236.	184.	143.	111.
87.	67.	53.	41.	32.	25.	21.	17.	12.	9.
9,	2,								

Sh 6

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.15	1	.00	0.00	.00	11.	1.02	13.45	151	.61	.60	.01	5533.
1.01	.30	2	.00	0.00	.00	10.	1.02	14.00	152	.61	.60	.01	6580.
1.01	.45	3	.00	0.00	.00	9.	1.02	14.15	153	.76	.75	.01	7585.
1.01	1.00	4	.00	0.00	.00	9.	1.02	14.30	154	.76	.75	.01	8502.
1.01	1.15	5	.00	0.00	.00	8.	1.02	14.45	155	.76	.75	.01	9328.
1.01	1.30	6	.00	0.00	.00	8.	1.02	15.00	156	.76	.75	.01	10128.
1.01	1.45	7	.00	0.00	.00	7.	1.02	15.15	157	.77	.76	.01	10894.
1.01	2.00	8	.00	0.00	.00	7.	1.02	15.30	158	1.55	1.53	.01	11723.
1.01	2.15	9	.00	0.00	.00	6.	1.02	15.45	159	4.33	4.32	.01	13126.
1.01	2.30	10	.00	0.00	.00	6.	1.02	16.00	160	1.08	1.07	.01	15139.
1.01	2.45	11	.00	0.00	.00	5.	1.02	16.15	161	.71	.70	.01	17844.
1.01	3.00	12	.00	0.00	.00	5.	1.02	16.30	162	.71	.70	.01	20922.
1.01	3.15	13	.00	0.00	.00	5.	1.02	16.45	163	.71	.70	.01	23212.
1.01	3.30	14	.00	0.00	.00	4.	1.02	17.00	164	.71	.70	.01	24262.
1.01	3.45	15	.00	0.00	.00	4.	1.02	17.15	165	.56	.55	.01	24212.
1.01	4.00	16	.00	0.00	.00	4.	1.02	17.30	166	.56	.55	.01	23270.
1.01	4.15	17	.00	0.00	.00	4.	1.02	17.45	167	.56	.55	.01	21834.
1.01	4.30	18	.00	0.00	.00	3.	1.02	18.00	168	.56	.55	.01	19913.
1.01	4.45	19	.00	0.00	.00	3.	1.02	18.15	169	.04	.03	.01	17852.
1.01	5.00	20	.00	0.00	.00	3.	1.02	18.30	170	.04	.03	.01	16134.
1.01	5.15	21	.00	0.00	.00	3.	1.02	18.45	171	.04	.03	.01	14456.
1.01	5.30	22	.00	0.00	.00	2.	1.02	19.00	172	.04	.03	.01	12728.
1.01	5.45	23	.00	0.00	.00	2.	1.02	19.15	173	.04	.03	.01	10887.
1.01	6.00	24	.00	0.00	.00	2.	1.02	19.30	174	.04	.03	.01	9085.
1.01	6.15	25	.01	0.00	.01	2.	1.02	19.45	175	.04	.03	.01	7442.
1.01	6.30	26	.01	0.00	.01	2.	1.02	20.00	176	.04	.03	.01	6006.
1.01	6.45	27	.01	0.00	.01	2.	1.02	20.15	177	.04	.03	.01	4787.
1.01	7.00	28	.01	0.00	.01	2.	1.02	20.30	178	.04	.03	.01	3815.
1.01	7.15	29	.01	0.00	.01	2.	1.02	20.45	179	.04	.03	.01	3090.
1.01	7.30	30	.01	0.00	.01	1.	1.02	21.00	180	.04	.03	.01	2528.
1.01	7.45	31	.01	0.00	.01	1.	1.02	21.15	181	.04	.03	.01	2095.
1.01	8.00	32	.01	0.00	.01	1.	1.02	21.30	182	.04	.03	.01	1748.
1.01	8.15	33	.01	0.00	.01	1.	1.02	21.45	183	.04	.03	.01	1477.
1.01	8.30	34	.01	0.00	.01	1.	1.02	22.00	184	.04	.03	.01	1269.
1.01	8.45	35	.01	0.00	.01	1.	1.02	22.15	185	.04	.03	.01	1161.
1.01	9.00	36	.01	0.00	.01	1.	1.02	22.30	186	.04	.03	.01	1083.
1.01	9.15	37	.01	0.00	.01	1.	1.02	22.45	187	.04	.03	.01	1010.
1.01	9.30	38	.01	0.00	.01	1.	1.02	23.00	188	.04	.03	.01	943.
1.01	9.45	39	.01	0.00	.01	1.	1.02	23.15	189	.04	.03	.01	880.
1.01	10.00	40	.01	0.00	.01	1.	1.02	23.30	190	.04	.03	.01	821.
1.01	10.15	41	.01	0.00	.01	1.	1.02	23.45	191	.04	.03	.01	766.
1.01	10.30	42	.01	0.00	.01	1.	1.03	0.00	192	.04	.03	.01	714.
1.01	10.45	43	.01	0.00	.01	1.	1.03	.15	193	0.00	0.00	0.00	667.
1.01	11.00	44	.01	0.00	.01	1.	1.03	.30	194	0.00	0.00	0.00	622.
1.01	11.15	45	.01	0.00	.01	1.	1.03	.45	195	0.00	0.00	0.00	580.
1.01	11.30	46	.01	0.00	.01	0.	1.03	1.00	196	0.00	0.00	0.00	541.
1.01	11.45	47	.01	0.00	.01	0.	1.03	1.15	197	0.00	0.00	0.00	505.
1.01	12.00	48	.01	0.00	.01	0.	1.03	1.30	198	0.00	0.00	0.00	471.
1.01	12.15	49	.04	0.00	.04	0.	1.03	1.45	199	0.00	0.00	0.00	440.
1.01	12.30	50	.04	0.00	.04	0.	1.03	2.00	200	0.00	0.00	0.00	410.
1.01	12.45	51	.04	0.00	.04	0.	1.03	2.15	201	0.00	0.00	0.00	383.
1.01	13.00	52	.04	0.00	.04	0.	1.03	2.30	202	0.00	0.00	0.00	357.
1.01	13.15	53	.05	0.00	.05	0.	1.03	2.45	203	0.00	0.00	0.00	333.
1.01	13.30	54	.05	0.00	.05	0.	1.03	3.00	204	0.00	0.00	0.00	311.
1.01	13.45	55	.05	0.00	.05	0.	1.03	3.15	205	0.00	0.00	0.00	290.
1.01	14.00	56	.05	0.00	.05	0.	1.03	3.30	206	0.00	0.00	0.00	271.
1.01	14.15	57	.06	0.00	.06	0.	1.03	3.45	207	0.00	0.00	0.00	253.
1.01	14.30	58	.06	0.00	.06	0.	1.03	4.00	208	0.00	0.00	0.00	236.
1.01	14.45	59	.06	0.00	.06	0.	1.03	4.15	209	0.00	0.00	0.00	220.
1.01	15.00	60	.06	0.00	.06	0.	1.03	4.30	210	0.00	0.00	0.00	205.
1.01	15.15	61	.06	0.00	.06	0.	1.03	4.45	211	0.00	0.00	0.00	191.
1.01	15.30	62	.12	0.00	.12	0.	1.03	5.00	212	0.00	0.00	0.00	179.
1.01	15.45	63	.33	.25	.08	38.	1.03	5.15	213	0.00	0.00	0.00	167.
1.01	16.00	64	.08	.07	.01	123.	1.03	5.30	214	0.00	0.00	0.00	155.
1.01	16.15	65	.05	.04	.01	268.	1.03	5.45	215	0.00	0.00	0.00	145.
1.01	16.30	66	.05	.04	.01	475.	1.03	6.00	216	0.00	0.00	0.00	135.

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1.01	17.00	68	.05	.04	.01	827.	1.03	6.30	218	0.00	0.00	0.00	118.
1.01	17.15	69	.04	.03	.01	924.	1.03	6.45	219	0.00	0.00	0.00	110.
1.01	17.30	70	.04	.03	.01	964.	1.03	7.00	220	0.00	0.00	0.00	103.
1.01	17.45	71	.04	.03	.01	968.	1.03	7.15	221	0.00	0.00	0.00	96.
1.01	18.00	72	.04	.03	.01	928.	1.03	7.30	222	0.00	0.00	0.00	89.
1.01	18.15	73	.00	0.00	.00	855.	1.03	7.45	223	0.00	0.00	0.00	83.
1.01	18.30	74	.00	0.00	.00	790.	1.03	8.00	224	0.00	0.00	0.00	78.
1.01	18.45	75	.00	0.00	.00	717.	1.03	8.15	225	0.00	0.00	0.00	73.
1.01	19.00	76	.00	0.00	.00	637.	1.03	8.30	226	0.00	0.00	0.00	68.
1.01	19.15	77	.00	0.00	.00	545.	1.03	8.45	227	0.00	0.00	0.00	63.
1.01	19.30	78	.00	0.00	.00	453.	1.03	9.00	228	0.00	0.00	0.00	59.
1.01	19.45	79	.00	0.00	.00	367.	1.03	9.15	229	0.00	0.00	0.00	55.
1.01	20.00	80	.00	0.00	.00	291.	1.03	9.30	230	0.00	0.00	0.00	51.
1.01	20.15	81	.00	0.00	.00	226.	1.03	9.45	231	0.00	0.00	0.00	48.
1.01	20.30	82	.00	0.00	.00	174.	1.03	10.00	232	0.00	0.00	0.00	45.
1.01	20.45	83	.00	0.00	.00	136.	1.03	10.15	233	0.00	0.00	0.00	42.
1.01	21.00	84	.00	0.00	.00	106.	1.03	10.30	234	0.00	0.00	0.00	39.
1.01	21.15	85	.00	0.00	.00	83.	1.03	10.45	235	0.00	0.00	0.00	36.
1.01	21.30	86	.00	0.00	.00	64.	1.03	11.00	236	0.00	0.00	0.00	34.
1.01	21.45	87	.00	0.00	.00	50.	1.03	11.15	237	0.00	0.00	0.00	32.
1.01	22.00	88	.00	0.00	.00	46.	1.03	11.30	238	0.00	0.00	0.00	29.
1.01	22.15	89	.00	0.00	.00	43.	1.03	11.45	239	0.00	0.00	0.00	27.
1.01	22.30	90	.00	0.00	.00	40.	1.03	12.00	240	0.00	0.00	0.00	26.
1.01	22.45	91	.00	0.00	.00	37.	1.03	12.15	241	0.00	0.00	0.00	24.
1.01	23.00	92	.00	0.00	.00	35.	1.03	12.30	242	0.00	0.00	0.00	22.
1.01	23.15	93	.00	0.00	.00	32.	1.03	12.45	243	0.00	0.00	0.00	21.
1.01	23.30	94	.00	0.00	.00	30.	1.03	13.00	244	0.00	0.00	0.00	19.
1.01	23.45	95	.00	0.00	.00	28.	1.03	13.15	245	0.00	0.00	0.00	18.
1.02	0.00	96	.00	0.00	.00	26.	1.03	13.30	246	0.00	0.00	0.00	17.
1.02	.15	97	.03	.01	.01	24.	1.03	13.45	247	0.00	0.00	0.00	16.
1.02	.30	98	.03	.01	.01	23.	1.03	14.00	248	0.00	0.00	0.00	15.
1.02	.45	99	.03	.01	.01	23.	1.03	14.15	249	0.00	0.00	0.00	14.
1.02	1.00	100	.03	.01	.01	45.	1.03	14.30	250	0.00	0.00	0.00	13.
1.02	1.15	101	.03	.01	.01	74.	1.03	14.45	251	0.00	0.00	0.00	12.
1.02	1.30	102	.03	.01	.01	107.	1.03	15.00	252	0.00	0.00	0.00	11.
1.02	1.45	103	.03	.01	.01	139.	1.03	15.15	253	0.00	0.00	0.00	10.
1.02	2.00	104	.03	.01	.01	169.	1.03	15.30	254	0.00	0.00	0.00	10.
1.02	2.15	105	.03	.01	.01	195.	1.03	15.45	255	0.00	0.00	0.00	9.
1.02	2.30	106	.03	.01	.01	215.	1.03	16.00	256	0.00	0.00	0.00	8.
1.02	2.45	107	.03	.01	.01	231.	1.03	16.15	257	0.00	0.00	0.00	8.
1.02	3.00	108	.03	.01	.01	243.	1.03	16.30	258	0.00	0.00	0.00	7.
1.02	3.15	109	.03	.01	.01	252.	1.03	16.45	259	0.00	0.00	0.00	7.
1.02	3.30	110	.03	.01	.01	259.	1.03	17.00	260	0.00	0.00	0.00	6.
1.02	3.45	111	.03	.01	.01	265.	1.03	17.15	261	0.00	0.00	0.00	6.
1.02	4.00	112	.03	.01	.01	269.	1.03	17.30	262	0.00	0.00	0.00	6.
1.02	4.15	113	.03	.01	.01	273.	1.03	17.45	263	0.00	0.00	0.00	5.
1.02	4.30	114	.03	.01	.01	275.	1.03	18.00	264	0.00	0.00	0.00	5.
1.02	4.45	115	.03	.01	.01	277.	1.03	18.15	265	0.00	0.00	0.00	5.
1.02	5.00	116	.03	.01	.01	279.	1.03	18.30	266	0.00	0.00	0.00	4.
1.02	5.15	117	.03	.01	.01	280.	1.03	18.45	267	0.00	0.00	0.00	4.
1.02	5.30	118	.03	.01	.01	281.	1.03	19.00	268	0.00	0.00	0.00	4.
1.02	5.45	119	.03	.01	.01	282.	1.03	19.15	269	0.00	0.00	0.00	3.
1.02	6.00	120	.03	.01	.01	283.	1.03	19.30	270	0.00	0.00	0.00	3.
1.02	6.15	121	.07	.06	.01	290.	1.03	19.45	271	0.00	0.00	0.00	3.
1.02	6.30	122	.07	.06	.01	312.	1.03	20.00	272	0.00	0.00	0.00	3.
1.02	6.45	123	.07	.06	.01	357.	1.03	20.15	273	0.00	0.00	0.00	3.
1.02	7.00	124	.07	.06	.01	431.	1.03	20.30	274	0.00	0.00	0.00	2.
1.02	7.15	125	.07	.06	.01	529.	1.03	20.45	275	0.00	0.00	0.00	2.
1.02	7.30	126	.07	.06	.01	636.	1.03	21.00	276	0.00	0.00	0.00	2.
1.02	7.45	127	.07	.06	.01	744.	1.03	21.15	277	0.00	0.00	0.00	2.
1.02	8.00	128	.07	.06	.01	843.	1.03	21.30	278	0.00	0.00	0.00	2.
1.02	8.15	129	.07	.06	.01	928.	1.03	21.45	279	0.00	0.00	0.00	2.
1.02	8.30	130	.07	.06	.01	997.	1.03	22.00	280	0.00	0.00	0.00	2.
1.02	8.45	131	.07	.06	.01	1048.	1.03	22.15	281	0.00	0.00	0.00	1.
1.02	9.00	132	.07	.06	.01	1087.	1.03	22.30	282	0.00	0.00	0.00	1.

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1.02	9.30	134	.07	.06	.01	1142.	1.03	23.00	284	0.00	0.00	0.00	1.
1.02	9.45	135	.07	.06	.01	1161.	1.03	23.15	285	0.00	0.00	0.00	1.
1.02	10.00	136	.07	.06	.01	1175.	1.03	23.30	286	0.00	0.00	0.00	1.
1.02	10.15	137	.07	.06	.01	1187.	1.03	23.45	287	0.00	0.00	0.00	1.
1.02	10.30	138	.07	.06	.01	1196.	1.04	0.00	288	0.00	0.00	0.00	1.
1.02	10.45	139	.07	.06	.01	1202.	1.04	.15	289	0.00	0.00	0.00	1.
1.02	11.00	140	.07	.06	.01	1208.	1.04	.30	290	0.00	0.00	0.00	1.
1.02	11.15	141	.07	.06	.01	1212.	1.04	.45	291	0.00	0.00	0.00	1.
1.02	11.30	142	.07	.06	.01	1215.	1.04	1.00	292	0.00	0.00	0.00	1.
1.02	11.45	143	.07	.06	.01	1218.	1.04	1.15	293	0.00	0.00	0.00	1.
1.02	12.00	144	.07	.06	.01	1220.	1.04	1.30	294	0.00	0.00	0.00	1.
1.02	12.15	145	.51	.50	.01	1287.	1.04	1.45	295	0.00	0.00	0.00	1.
1.02	12.30	146	.51	.50	.01	1484.	1.04	2.00	296	0.00	0.00	0.00	1.
1.02	12.45	147	.51	.50	.01	1885.	1.04	2.15	297	0.00	0.00	0.00	0.
1.02	13.00	148	.51	.50	.01	2556.	1.04	2.30	298	0.00	0.00	0.00	0.
1.02	13.15	149	.61	.60	.01	3449.	1.04	2.45	299	0.00	0.00	0.00	0.
1.02	13.30	150	.61	.60	.01	4467.	1.04	3.00	300	0.00	0.00	0.00	0.
									SUM	25.56	23.16	2.40	461236.
										(649.)	(588.)	(61.)	(13060.75)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	24262.	14865.	4618.	1601.	461227.
CMS	687.	421.	131.	45.	13060.
INCHES		18.20	22.61	23.52	23.52
MM		462.16	574.25	597.46	597.47
AC-FT		7371.	9159.	9529.	9529.
THOUS CU M		9092.	11298.	11754.	11754.

HYDROGRAPH AT STAINFLOW FOR PLAN 1, RTIO 1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1213.	743.	231.	80.	23061.
CMS	34.	21.	7.	2.	653.
INCHES		.91	1.13	1.18	1.18
MM		23.11	28.71	29.87	29.87
AC-FT		369.	458.	476.	476.
THOUS CU M		455.	565.	588.	588.

HYDROGRAPH AT STAINFLOW FOR PLAN 1, RTIO 2

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2426.	1487.	462.	160.	46123.
CMS	69.	42.	13.	5.	1306.
INCHES		1.82	2.26	2.35	2.35
MM		46.22	57.43	59.75	59.75
AC-FT		737.	916.	953.	953.
THOUS CU M		909.	1130.	1175.	1175.

HYDROGRAPH AT STAINFLOW FOR PLAN 1, RTIO 3

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3639.	2230.	693.	240.	69184.
CMS	103.	63.	20.	7.	1959.
INCHES		2.73	3.39	3.53	3.53
MM		69.32	86.14	89.62	89.62
AC-FT		1106.	1374.	1429.	1429.
THOUS CU M		1364.	1695.	1763.	1763.

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HYDROGRAPH AT STAINFLOW FOR PLAN 1, RTIO 4

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4852.	2973.	924.	320.	92245.
CMS	137.	84.	26.	9.	2612.
INCHES		3.64	4.52	4.70	4.70
MM		92.43	114.85	119.49	119.49
AC-FT		1474.	1832.	1906.	1906.
THOUS CU M		1818.	2260.	2351.	2351.

HYDROGRAPH AT STAINFLOW FOR PLAN 1, RTIO 5

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6066.	3716.	1154.	400.	115307.
CMS	172.	105.	33.	11.	3265.
INCHES		4.55	5.65	5.88	5.88
MM		115.54	143.56	149.37	149.37
AC-FT		1843.	2290.	2382.	2382.
THOUS CU M		2273.	2824.	2939.	2939.

HYDROGRAPH AT STAINFLOW FOR PLAN 1, RTIO 6

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	7279.	4460.	1385.	480.	138368.
CMS	206.	126.	39.	14.	3918.
INCHES		5.46	6.78	7.06	7.06
MM		138.65	172.28	179.24	179.24
AC-FT		2211.	2748.	2859.	2859.
THOUS CU M		2728.	3389.	3526.	3526.

HYDROGRAPH AT STAINFLOW FOR PLAN 1, RTIO 7

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	12131.	7433.	2309.	801.	230614.
CMS	344.	210.	65.	23.	6530.
INCHES		9.10	11.30	11.76	11.76
MM		231.08	287.13	298.73	298.73
AC-FT		3686.	4580.	4765.	4765.
THOUS CU M		4546.	5649.	5877.	5877.

HYDROGRAPH AT STAINFLOW FOR PLAN 1, RTIO 8

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	18197.	11149.	3463.	1201.	345920.
CMS	515.	316.	98.	34.	9795.
INCHES		13.65	16.96	17.64	17.64
MM		346.62	430.69	448.10	448.10
AC-FT		5528.	6869.	7147.	7147.
THOUS CU M		6819.	8473.	8816.	8816.

HYDROGRAPH AT STAINFLOW FOR PLAN 1, RTIO 9

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	24262.	14865.	4618.	1601.	461227.
CMS	687.	421.	131.	45.	13060.
INCHES		18.20	22.61	23.52	23.52
MM		462.16	574.25	597.46	597.47
AC-FT		7371.	9159.	9529.	9529.
THOUS CU M		9092.	11298.	11754.	11754.

HYDROGRAPH ROUTING

OUTFLOW FROM LAKE SHAWNEE DAM

	ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
OUTFLO	1	1	0	0	0	0	1	0	0

ROUTING DATA

GLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-935.	-1

STAGE	935.00	936.00	937.20	938.00	940.00	945.00
FLOW	0.00	160.00	522.00	1433.00	10456.00	54510.00
SURFACE AREA=	0.	79.	118.	258.		
CAPACITY=	0.	184.	674.	4343.		
ELEVATION=	928.	935.	940.	960.		

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
935.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
937.2	0.0	0.0	0.

STATION OUTFLO, PLAN 1, RATIO 1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	782.	538.	220.	80.	23005.
CMS	22.	15.	6.	2.	651.
INCHES		.66	1.08	1.17	1.17
MM		16.74	27.39	29.80	29.80
AC-FT		267.	437.	475.	475.
THOUS CU M		329.	539.	586.	586.

STATION OUTFLO, PLAN 1, RATIO 2

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2279.	1275.	447.	160.	46044.
CMS	65.	36.	13.	5.	1304.
INCHES		1.56	2.19	2.35	2.35
MM		39.65	55.62	59.64	59.64
AC-FT		632.	887.	951.	951.
THOUS CU M		780.	1094.	1173.	1173.

STATION OUTFLO, PLAN 1, RATIO 3

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3546.	2050.	676.	240.	69094.
CMS	100.	58.	19.	7.	1957.
INCHES		2.51	3.31	3.52	3.52
MM		63.74	84.05	89.50	89.50
AC-FT		1017.	1341.	1427.	1428.
THOUS CU M		1254.	1654.	1761.	1761.

STATION OUTFLO, PLAN 1, RATIO 4

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4731.	2819.	905.	320.	92132.
CMS	134.	80.	26.	9.	2609.
INCHES		3.45	4.43	4.70	4.70
MM		87.65	112.54	119.34	119.35
AC-FT		1398.	1795.	1903.	1904.
THOUS CU M		1724.	2214.	2348.	2348.

Sh 11

STATION OUTFLO, PLAN 1, RATIO 5

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	5910.	3588.	1135.	400.	115181.
CMS	167.	102.	32.	11.	3262.
INCHES		4.39	5.56	5.87	5.87
MM		111.54	141.11	149.20	149.20
AC-FT		1779.	2251.	2380.	2380.
THOUS CU M		2194.	2776.	2935.	2935.

STATION OUTFLO, PLAN 1, RATIO 6

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	7087.	4358.	1365.	480.	138228.
CMS	201.	123.	39.	14.	3914.
INCHES		5.33	6.68	7.05	7.05
MM		135.49	169.72	179.05	179.06
AC-FT		2161.	2707.	2856.	2856.
THOUS CU M		2666.	3339.	3523.	3523.

STATION OUTFLO, PLAN 1, RATIO 7 (½ PMF)

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	3.	6.	14.	25.	39.	55.	71.
87.	102.	116.	127.	137.	144.	150.	154.	156.	156.
155.	153.	150.	147.	143.	139.	135.	130.	126.	122.
118.	114.	111.	107.	103.	100.	97.	93.	90.	87.
85.	83.	83.	82.	83.	83.	85.	86.	87.	89.
91.	92.	94.	96.	97.	99.	100.	102.	104.	105.
106.	108.	110.	114.	119.	125.	134.	144.	155.	173.
197.	220.	243.	264.	285.	305.	324.	342.	359.	375.
390.	404.	418.	430.	443.	459.	483.	526.	739.	1006.
1322.	2168.	3020.	3636.	4138.	4579.	4988.	5389.	5882.	6586.
7564.	8801.	10080.	11435.	12028.	11892.	11357.	10557.	9888.	9091.
8257.	7404.	6519.	5610.	4720.	3894.	3160.	2536.	2032.	1639.
1401.	1309.	1203.	1094.	990.	898.	818.	746.	683.	627.
577.	532.	513.	501.	488.	475.	462.	448.	434.	419.
405.	391.	376.	362.	348.	335.	321.	308.	295.	282.
270.	258.	246.	235.	224.	213.	203.	193.	184.	175.
166.	159.	155.	150.	146.	142.	138.	134.	130.	126.
122.	118.	114.	111.	107.	104.	100.	97.	94.	91.
88.	85.	82.	79.	76.	74.	71.	68.	66.	64.
61.	59.	57.	55.	53.	51.	49.	47.	46.	44.
42.	41.	39.	38.	36.	35.	34.	32.	31.	30.
29.	28.	27.	26.	25.	24.	23.	22.	21.	20.
19.	19.	18.	17.	17.	16.	15.	15.	14.	14.

Sh 12

STORAGE

184.	185.	185.	185.	185.	185.	185.	185.	185.	185.
185.	185.	185.	185.	185.	185.	185.	185.	185.	185.
185.	185.	185.	185.	185.	185.	185.	185.	185.	185.
185.	185.	185.	185.	185.	185.	185.	185.	185.	185.
185.	185.	185.	185.	185.	185.	185.	185.	185.	185.
185.	185.	185.	185.	185.	185.	185.	185.	185.	185.
185.	185.	185.	186.	187.	191.	197.	204.	212.	220.
229.	236.	243.	249.	254.	258.	261.	263.	265.	265.
264.	263.	262.	260.	258.	256.	253.	251.	249.	247.
245.	243.	241.	239.	237.	235.	233.	232.	230.	228.
227.	227.	226.	226.	226.	227.	227.	228.	229.	229.
230.	231.	232.	233.	234.	235.	235.	236.	237.	238.
238.	239.	241.	242.	245.	248.	253.	258.	264.	271.
277.	284.	291.	297.	303.	309.	315.	320.	325.	330.
335.	339.	343.	347.	351.	356.	364.	376.	394.	417.
444.	471.	491.	505.	517.	527.	537.	546.	558.	575.
600.	631.	664.	687.	695.	693.	686.	675.	659.	638.
617.	596.	574.	552.	530.	511.	494.	479.	468.	459.
451.	443.	434.	424.	415.	408.	401.	395.	389.	384.
380.	377.	373.	369.	365.	361.	357.	352.	348.	344.
339.	335.	331.	326.	322.	318.	314.	310.	306.	302.
299.	295.	292.	289.	285.	282.	279.	276.	274.	271.
269.	266.	264.	262.	259.	257.	255.	253.	251.	249.
247.	245.	243.	241.	239.	237.	235.	234.	232.	230.
229.	227.	226.	224.	223.	221.	220.	219.	218.	216.
215.	214.	213.	212.	211.	210.	209.	208.	207.	206.
205.	205.	204.	203.	202.	202.	201.	200.	200.	199.
199.	198.	198.	197.	197.	196.	196.	195.	195.	194.
194.	194.	193.	193.	193.	192.	192.	192.	191.	191.
191.	191.	190.	190.	190.	190.	189.	189.	189.	189.

STAGE

935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0
935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0
935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0
935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0
935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0
935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0
935.0	935.0	935.0	935.0	935.0	935.1	935.2	935.2	935.3	935.4
935.5	935.6	935.7	935.8	935.9	935.9	935.9	936.0	936.0	936.0
936.0	936.0	935.9	935.9	935.9	935.9	935.8	935.8	935.8	935.8
935.7	935.7	935.7	935.7	935.6	935.6	935.6	935.6	935.6	935.5
935.5	935.5	935.5	935.5	935.5	935.5	935.5	935.5	935.5	935.6
935.6	935.6	935.6	935.6	935.6	935.6	935.6	935.6	935.6	935.7
935.7	935.7	935.7	935.7	935.7	935.8	935.8	935.9	936.0	936.0
936.1	936.2	936.3	936.3	936.4	936.5	936.5	936.6	936.7	936.7
936.8	936.8	936.9	936.9	936.9	937.0	937.1	937.2	937.4	937.6
937.9	938.2	938.4	938.5	938.6	938.7	938.8	938.9	939.0	939.1
939.4	939.6	939.9	940.1	940.2	940.2	940.1	940.0	939.9	939.7
939.5	939.3	939.1	938.9	938.7	938.5	938.4	938.2	938.1	938.0
938.0	937.9	937.8	937.7	937.6	937.5	937.5	937.4	937.3	937.3
937.2	937.2	937.2	937.1	937.1	937.0	937.0	937.0	936.9	936.9
936.8	936.8	936.7	936.7	936.6	936.6	936.5	936.5	936.4	936.4
936.4	936.3	936.3	936.2	936.2	936.2	936.1	936.1	936.1	936.0
936.0	936.0	936.0	935.9	935.9	935.9	935.9	935.8	935.8	935.8
935.8	935.7	935.7	935.7	935.7	935.6	935.6	935.6	935.6	935.6
935.5	935.5	935.5	935.5	935.5	935.5	935.4	935.4	935.4	935.4
935.4	935.4	935.4	935.3	935.3	935.3	935.3	935.3	935.3	935.3
935.3	935.3	935.2	935.2	935.2	935.2	935.2	935.2	935.2	935.2
935.2	935.2	935.2	935.2	935.2	935.1	935.1	935.1	935.1	935.1
935.1	935.1	935.1	935.1	935.1	935.1	935.1	935.1	935.1	935.1
935.1	935.1	935.1	935.1	935.1	935.1	935.1	935.1	935.1	935.1

PEAK OUTFLOW IS 12028. AT TIME 41.25 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	12028.	7391.	2287.	800.	230421.
CMS	341.	209.	65.	23.	6525.
INCHES		9.05	11.20	11.75	11.75
MM		229.78	284.45	298.47	298.48
AC-FT		3665.	4537.	4761.	4761.
THOUS CU M		4521.	5596.	5872.	5872.

Sh 13

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	18088.	11098.	3443.	1200.	345709.
CMS	512.	314.	97.	34.	9789.
INCHES		13.58	16.86	17.63	17.63
MM		345.03	428.14	447.81	447.83
AC-FT		5503.	6829.	7142.	7143.
THOUS CU M		6788.	8423.	8810.	8810.

STATION OUTFLO, PLAN 1, RATIO 9 (PMF)

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	1.	1.	2.	2.	2.	2.	2.	3.	3.
3.	3.	3.	3.	3.	3.	3.	3.	3.	3.
3.	3.	3.	3.	3.	3.	3.	3.	3.	3.
3.	3.	3.	3.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	2.	5.	13.	27.	49.	77.	108.	140.
181.	234.	279.	315.	345.	366.	381.	389.	390.	386.
378.	366.	352.	337.	321.	304.	288.	272.	256.	242.
228.	215.	202.	190.	179.	169.	159.	154.	149.	145.
142.	140.	139.	140.	141.	144.	147.	150.	154.	158.
163.	170.	177.	184.	190.	196.	202.	207.	212.	217.
222.	227.	235.	246.	262.	283.	311.	343.	379.	417.
456.	495.	563.	687.	788.	870.	937.	991.	1035.	1070.
1099.	1122.	1141.	1157.	1176.	1220.	1318.	1653.	2496.	3400.
4378.	5392.	6401.	7370.	8272.	9114.	9913.	10839.	12216.	13872.
16122.	18901.	21577.	23390.	24098.	23800.	22755.	21173.	19237.	17329.
15590.	13873.	12089.	10329.	9150.	7744.	6361.	5128.	4112.	3314.
2695.	2214.	1838.	1546.	1402.	1343.	1281.	1217.	1153.	1088.
1026.	965.	906.	850.	796.	745.	697.	652.	610.	570.
532.	515.	504.	493.	481.	468.	455.	442.	428.	414.
400.	386.	372.	358.	345.	331.	318.	305.	292.	279.
267.	255.	244.	233.	222.	212.	202.	192.	182.	174.
165.	158.	154.	150.	145.	141.	137.	133.	129.	125.
121.	118.	114.	110.	107.	103.	100.	97.	93.	90.
87.	84.	81.	79.	76.	73.	71.	68.	66.	63.
61.	59.	57.	55.	53.	51.	49.	47.	46.	44.
42.	41.	39.	38.	36.	35.	34.	32.	31.	30.
29.	28.	27.	26.	25.	24.	23.	22.	21.	20.
19.	19.	18.	17.	17.	16.	15.	15.	14.	14.

STORAGE

185.	185.	185.	185.	185.	185.	185.	186.	186.	186.
186.	186.	186.	186.	186.	186.	186.	186.	186.	186.
186.	186.	186.	186.	186.	186.	186.	186.	186.	186.
186.	186.	186.	186.	186.	186.	185.	185.	185.	185.
185.	185.	185.	185.	185.	185.	185.	185.	185.	185.
185.	185.	185.	185.	185.	185.	185.	185.	185.	185.
185.	185.	185.	187.	191.	198.	209.	223.	239.	256.
273.	288.	301.	312.	321.	328.	332.	334.	335.	334.
331.	328.	323.	319.	314.	309.	304.	299.	295.	290.
286.	283.	279.	276.	272.	269.	267.	264.	261.	259.
257.	256.	256.	256.	257.	258.	260.	262.	264.	266.
268.	270.	272.	274.	276.	277.	279.	281.	282.	283.
285.	286.	288.	292.	296.	303.	311.	320.	331.	343.
355.	367.	379.	390.	398.	405.	411.	416.	419.	422.
425.	427.	429.	430.	432.	436.	444.	459.	478.	499.
522.	546.	571.	595.	617.	639.	659.	679.	697.	720.
751.	789.	827.	853.	863.	859.	844.	821.	794.	767.
743.	720.	696.	670.	640.	604.	570.	540.	516.	497.
483.	472.	463.	457.	452.	446.	441.	435.	430.	424.
419.	413.	408.	403.	399.	394.	390.	387.	383.	380.
377.	373.	370.	367.	363.	359.	355.	351.	346.	342.
338.	334.	329.	325.	321.	317.	313.	309.	305.	302.
298.	295.	291.	288.	285.	282.	279.	276.	273.	271.
268.	266.	264.	261.	259.	257.	255.	252.	250.	248.
246.	244.	242.	240.	239.	237.	235.	233.	232.	230.
228.	227.	225.	224.	223.	221.	220.	219.	217.	216.
215.	214.	213.	212.	211.	210.	209.	208.	207.	206.
205.	205.	204.	203.	202.	202.	201.	200.	200.	199.
199.	198.	198.	197.	197.	196.	196.	195.	195.	194.
194.	194.	193.	193.	193.	192.	192.	192.	191.	191.

Sh 14

STAGE

935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0
935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0
935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0
935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0
935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0
935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0	935.0
935.0	935.0	935.0	935.0	935.1	935.2	935.3	935.5	935.7	935.9
936.1	936.2	936.4	936.5	936.6	936.7	936.7	936.8	936.8	936.7
936.7	936.7	936.6	936.6	936.5	936.5	936.4	936.4	936.3	936.3
936.2	936.2	936.1	936.1	936.1	936.0	936.0	936.0	935.9	935.9
935.9	935.9	935.9	935.9	935.9	935.9	935.9	935.9	936.0	936.0
936.0	936.0	936.1	936.1	936.1	936.1	936.1	936.2	936.2	936.2
936.2	936.2	936.2	936.3	936.3	936.4	936.5	936.6	936.7	936.9
937.0	937.1	937.2	937.3	937.4	937.5	937.6	937.6	937.7	937.7
937.7	937.7	937.7	937.8	937.8	937.8	937.9	938.0	938.2	938.4
938.7	938.9	939.1	939.3	939.5	939.7	939.9	940.0	940.2	940.4
940.6	941.0	941.3	941.5	941.5	941.5	941.4	941.2	941.0	940.8
940.6	940.4	940.2	940.0	939.7	939.4	939.1	938.8	938.6	938.4
938.3	938.2	938.1	938.0	938.0	937.9	937.9	937.8	937.8	937.7
937.6	937.6	937.5	937.5	937.4	937.4	937.4	937.3	937.3	937.2
937.2	937.2	937.1	937.1	937.1	937.0	937.0	936.9	936.9	936.8
936.8	936.7	936.7	936.7	936.6	936.6	936.5	936.5	936.4	936.4
936.4	936.3	936.3	936.2	936.2	936.2	936.1	936.1	936.1	936.0
936.0	936.0	936.0	935.9	935.9	935.9	935.9	935.8	935.8	935.8
935.8	935.7	935.7	935.7	935.7	935.6	935.6	935.6	935.6	935.6
935.5	935.5	935.5	935.5	935.5	935.5	935.4	935.4	935.4	935.4
935.4	935.4	935.4	935.3	935.3	935.3	935.3	935.3	935.3	935.3
935.3	935.3	935.2	935.2	935.2	935.2	935.2	935.2	935.2	935.2
935.2	935.2	935.2	935.2	935.2	935.1	935.1	935.1	935.1	935.1
935.1	935.1	935.1	935.1	935.1	935.1	935.1	935.1	935.1	935.1

PEAK OUTFLOW IS 24098. AT TIME 41.25 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	24098.	14797.	4596.	1600.	460952.
CMS	682.	419.	130.	45.	13053.
INCHES		18.11	22.50	23.51	23.51
MM		460.04	571.56	597.08	597.11
AC-FT		7338.	9116.	9523.	9524.
THOUS CU M		9051.	11245.	11747.	11747.

UNITED COMPUTING SYSTEMS, INC.

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

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				RATIOS APPLIED TO FLOWS								
OPERATION	STATION	AREA	PLAN	RATIO 1 .05	RATIO 2 .10	RATIO 3 .15	RATIO 4 .20	RATIO 5 .25	RATIO 6 .30	RATIO 7 .50	RATIO 8 .75	RATIO 9 1.00
HYDROGRAPH AT	INFLOW	7.60	1	1213.	2426.	3639.	4852.	6066.	7279.	12131.	18197.	24262.
		(19.68)		(34.35)(	68.70)(	103.05)(	137.41)(	171.76)(	206.11)(	343.51)(	515.27)(	687.03)
ROUTED TO	OUTFLO	7.60	1	782.	2279.	3546.	4731.	5910.	7087.	12028.	18088.	24098.
		(19.68)		(22.14)(	64.54)(	100.42)(	133.97)(	167.37)(	200.68)(	340.59)(	512.18)(	682.39)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	935.00	935.00	937.20
STORAGE	184.	184.	376.
OUTFLOW	0.	0.	522.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.05	937.43	.23	398.	782.	2.50	42.50	0.00
.10	938.19	.99	473.	2279.	5.25	41.50	0.00
.15	938.47	1.27	503.	3546.	6.75	41.50	0.00
.20	938.73	1.53	531.	4731.	7.50	41.50	0.00
.25	938.99	1.79	559.	5910.	8.50	41.50	0.00
.30	939.25	2.05	588.	7087.	9.00	41.50	0.00
.50	940.18	2.98	695.	12028.	11.25	41.25	0.00
.75	940.87	3.67	778.	18088.	15.00	41.25	0.00
1.00	941.55	4.35	863.	24098.	17.25	41.25	0.00

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APPENDIX

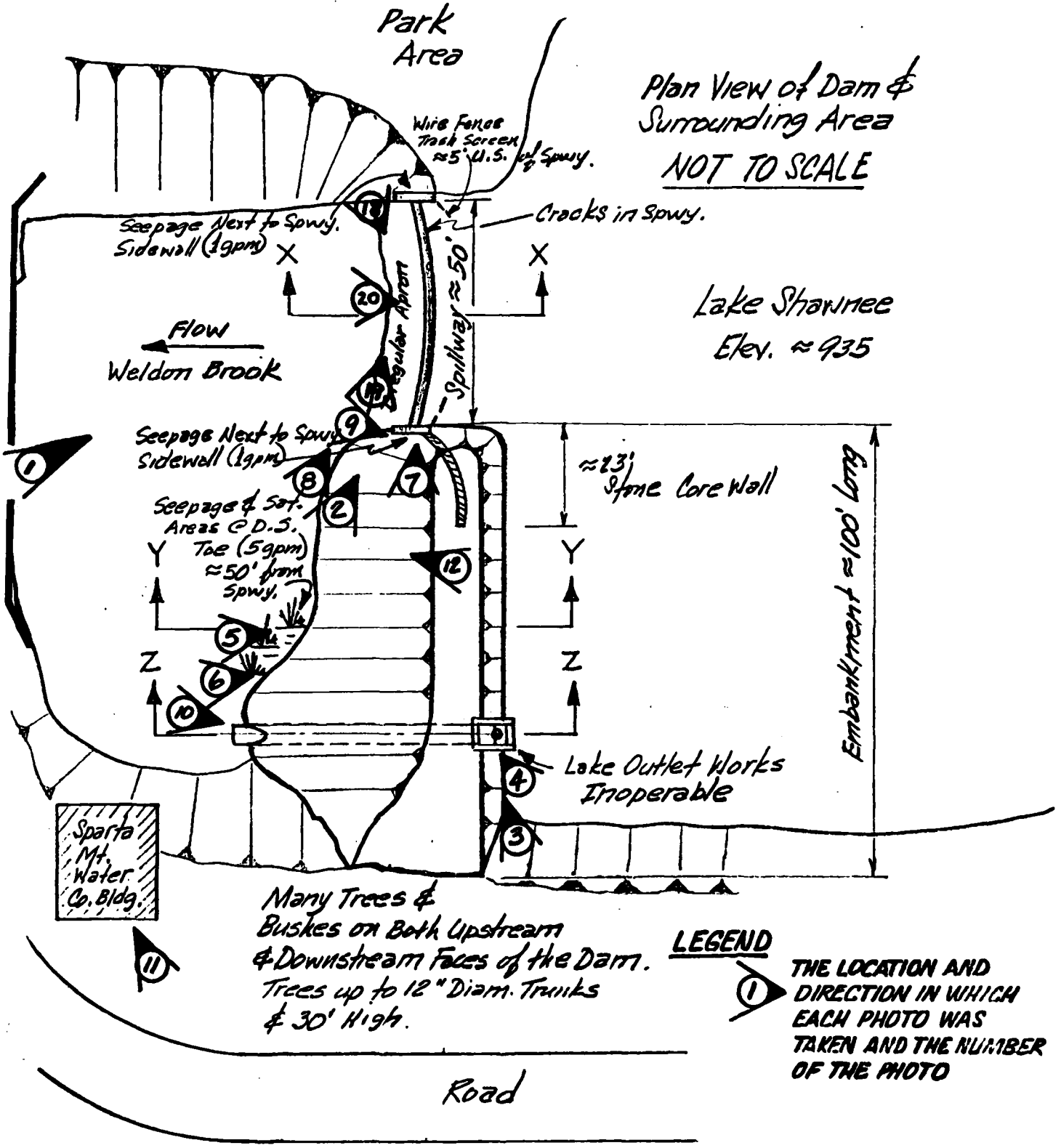
D

Photographs

APPENDIX D
SELECTED PHOTOGRAPHS OF THE SITE

O'BRIEN & GERE
ENGINEERS, INC.

SUBJECT	SHEET	BY	DATE	JOB NO
Lake Shawnee Dam, Phila. COE, Open End	A	[illegible]	6/3/80	1800-006-103



1. SPILLWAY AND ABUTMENT AS OBSERVED FROM BRIDGE ABOUT 150 FEET DOWNSTREAM. (5/28/80)

2. DOWNSTREAM FACE OF THE DAM ADJACENT TO THE LEFT SIDEWALL OF THE SPILLWAY. (5/28/80)

3. INLET STRUCTURE FOR THE OUTLET WORKS. (5/28/80)

4. CLOSE UP OF THE INLET STRUCTURE FOR THE OUTLET WORKS SHOWING THE RESERVOIR DRAIN GATE FRAME AND STEM. (5/28/80)

5. FLOWING SEEPAGE AT THE DOWNSTREAM TOE OF THE EMBANKMENT ABOUT 50 FEET TO THE LEFT OF THE SPILLWAY. (5/28/80)

6. STANDING WATER AT THE DOWNSTREAM TOE OF THE EMBANKMENT ABOUT 60 FEET LEFT OF THE SPILLWAY. (5/28/80)

7. SPILLWAY AS OBSERVED FROM THE LEFT SIDEWALL SHOWING DEBRIS BUILDUP ON THE TRASH SCREEN AND THE POOR CONDITION OF THE SIDEWALL. (5/28/80)

8. SPILLWAY AS OBSERVED FROM THE LEFT DOWNSTREAM SIDE OF THE APRON SHOWING THE IRREGULAR APRON AND POOR CONDITION OF THE RIGHT SIDEWALL. (5/28/80)

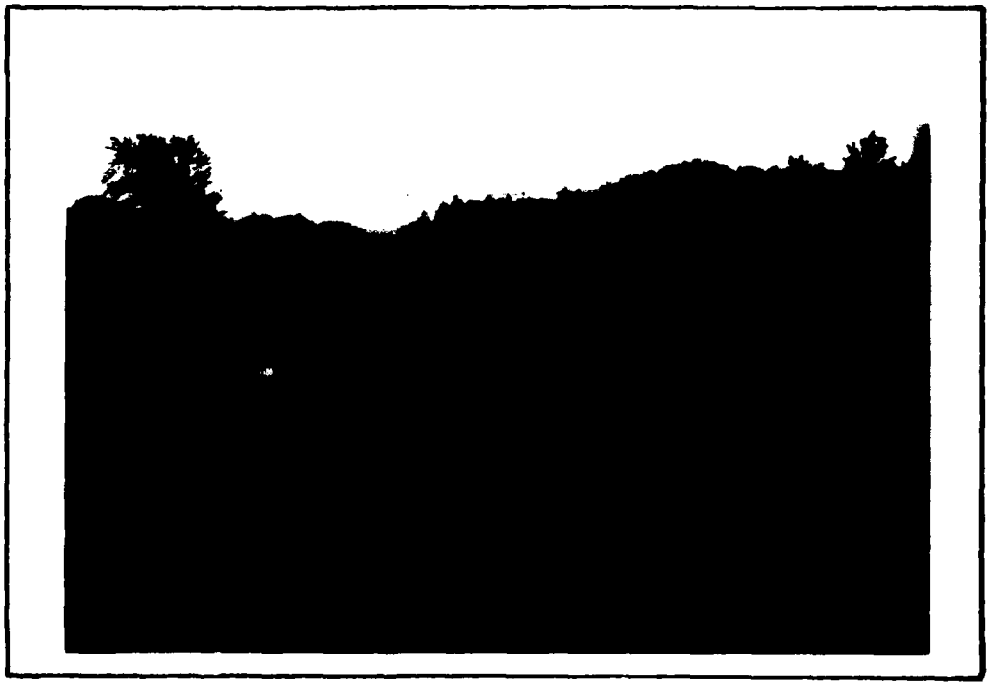
9. SEEPAGE IN THE VICINITY OF THE LEFT SIDEWALL OF THE SPILLWAY. (5/28/80)

10. PARTIALLY FILLED OUTLET PIPE OF RESERVOIR OUTLET WORKS. (5/28/80)

11. BUILDING OF THE SPARTA MOUNTAIN WATER CO. IMMEDIATELY DOWNSTREAM. (5/28/80)

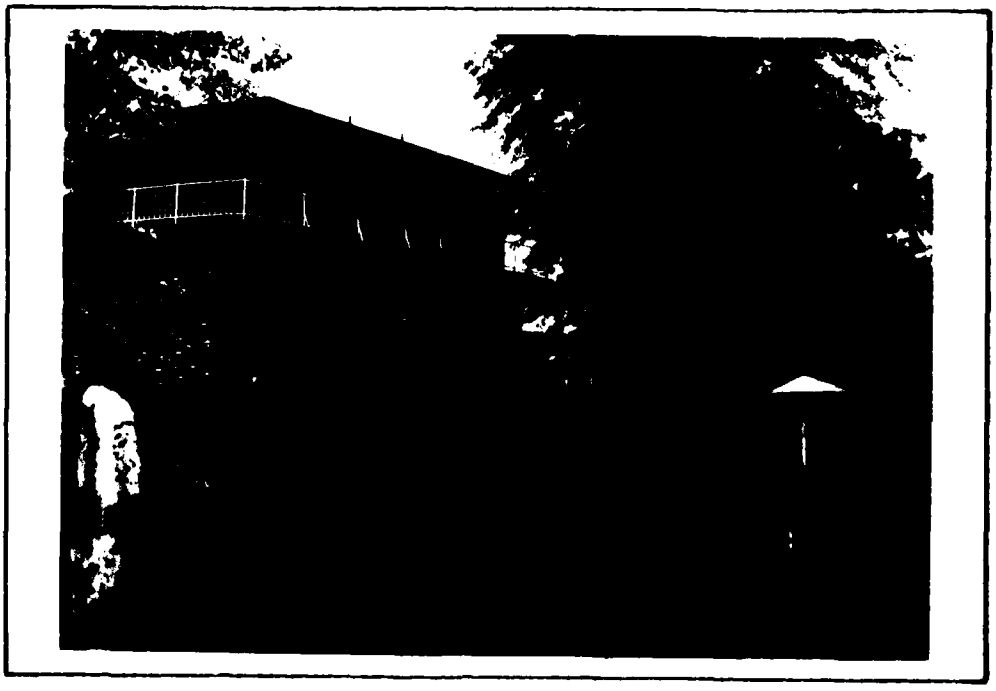
12. BRIDGE ON WELDON BROOK ABOUT 150 FEET DOWNSTREAM OF THE DAM. (5/28/80)

13. VIEW LOOKING DOWNSTREAM SHOWING HIGHWAY BRIDGES ABOUT 250 FEET AND 400 FEET DOWNSTREAM OF THE DAM. (5/28/80)

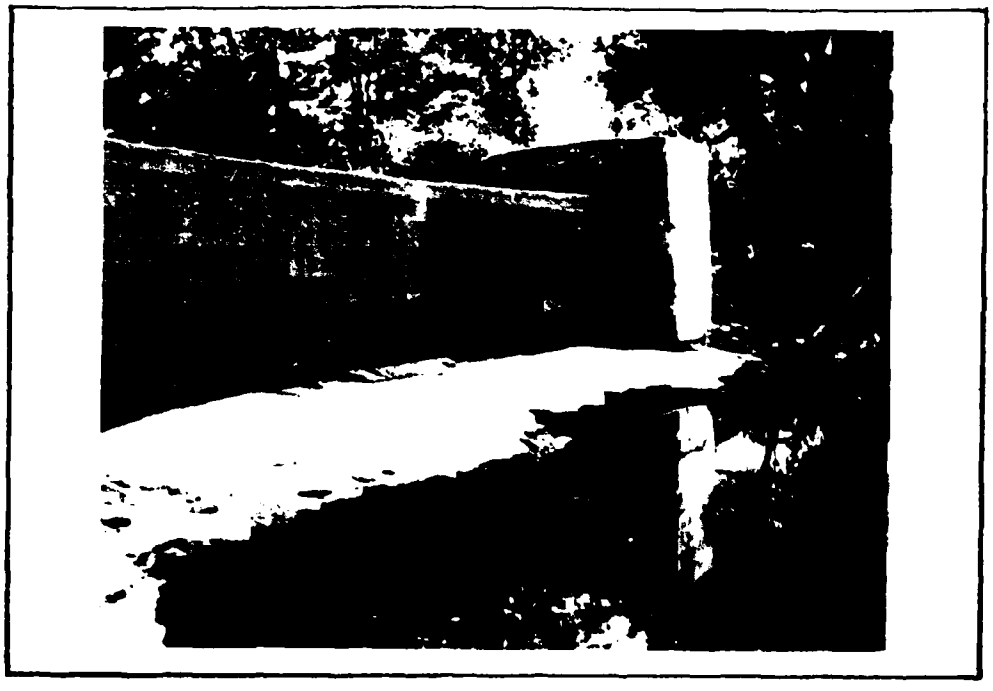


14. VIEW LOOKING DOWNSTREAM SHOWING HIGHWAY BRIDGE ABOUT 400 FEET DOWNSTREAM OF THE DAM. (5/28/80)

15. POTENTIAL DAMAGE AREA APPROXIMATELY 0.5 MILES DOWNSTREAM OF THE DAM. (5/28/80)

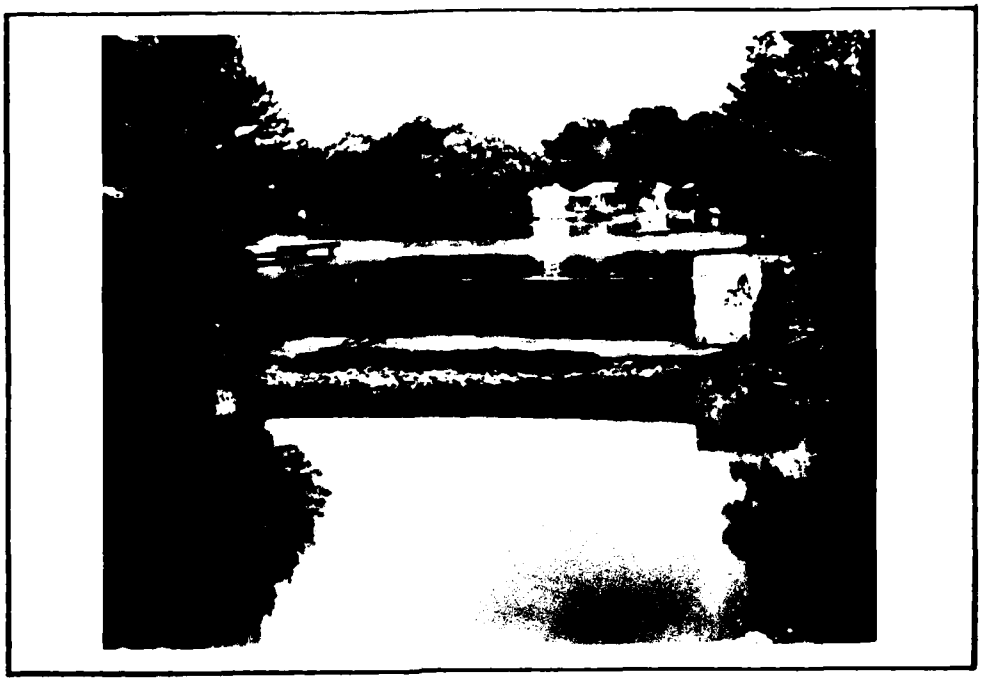


16. POTENTIAL DAMAGE AREA APPROXIMATELY 0.5 MILES DOWNSTREAM OF THE DAM. (5/28/80)



17. VIEW OF LEFT SIDE OF SPILLWAY AND DOWNSTREAM APRON IN DRAWN DOWN CONDITION. (6/19/80)

18. VIEW OF RIGHT SIDE OF SPILLWAY AND DOWNSTREAM APRON IN DRAWN DOWN CONDITION. (6/19/80)



19. VIEW OF SPILLWAY AND APRON IN DRAWN DOWN CONDITION FROM DOWNSTREAM BRIDGE. (6/19/80)

20. CLOSE-UP OF DOWNSTREAM FACE OF SPILLWAY SHOWING MAGNITUDE OF CRACKS AND HOLES IN CONCRETE. (6/19/80)

APPENDIX

E

Drawings

O'BRIEN & GERE
ENGINEERS, INC.

SUBJECT	SHEET	BY	DATE	JOB NO
Lake Shawnee Dam, Phila COE, Open End				

APPENDIX E

TABLE OF CONTENTS

DRAWINGS

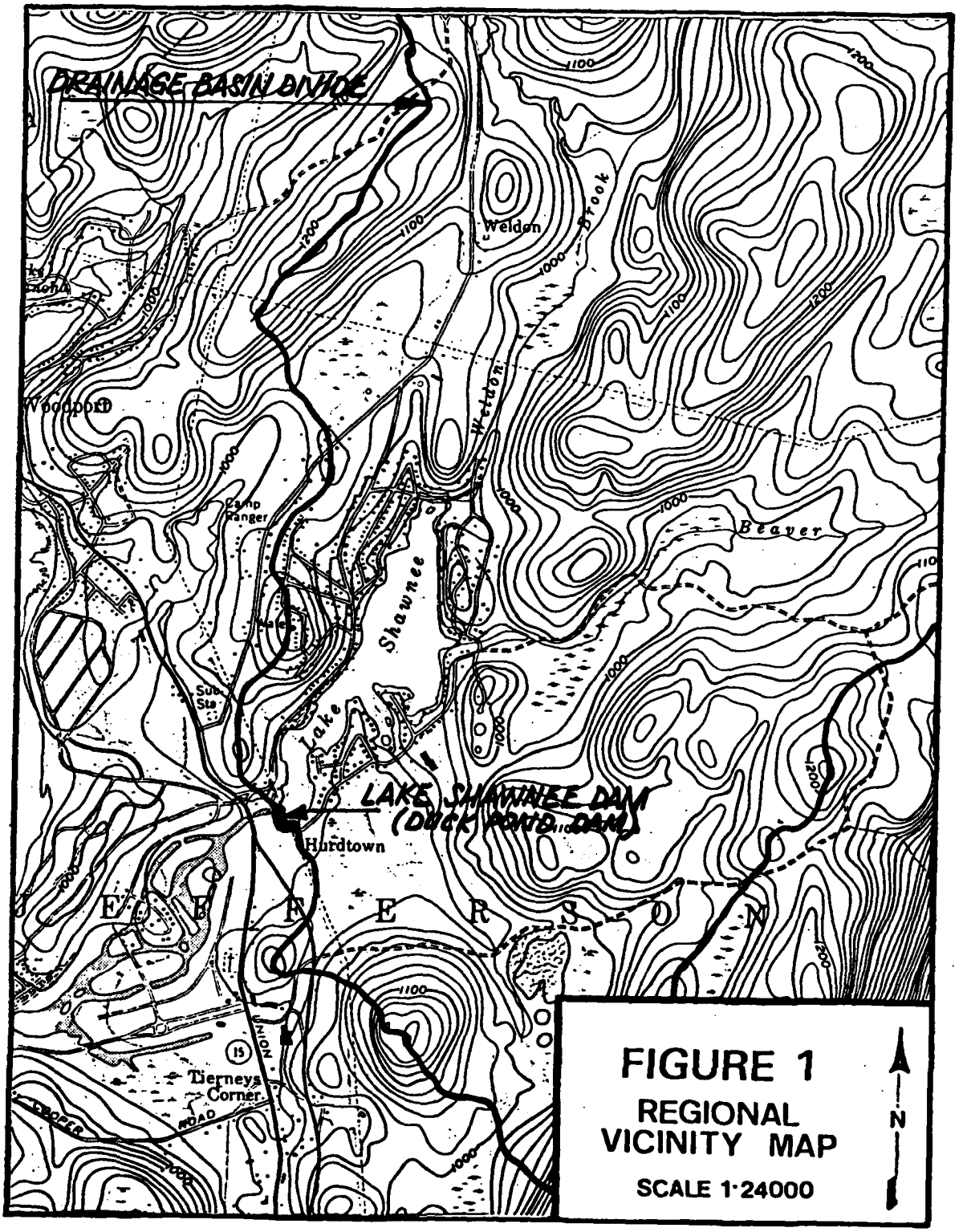


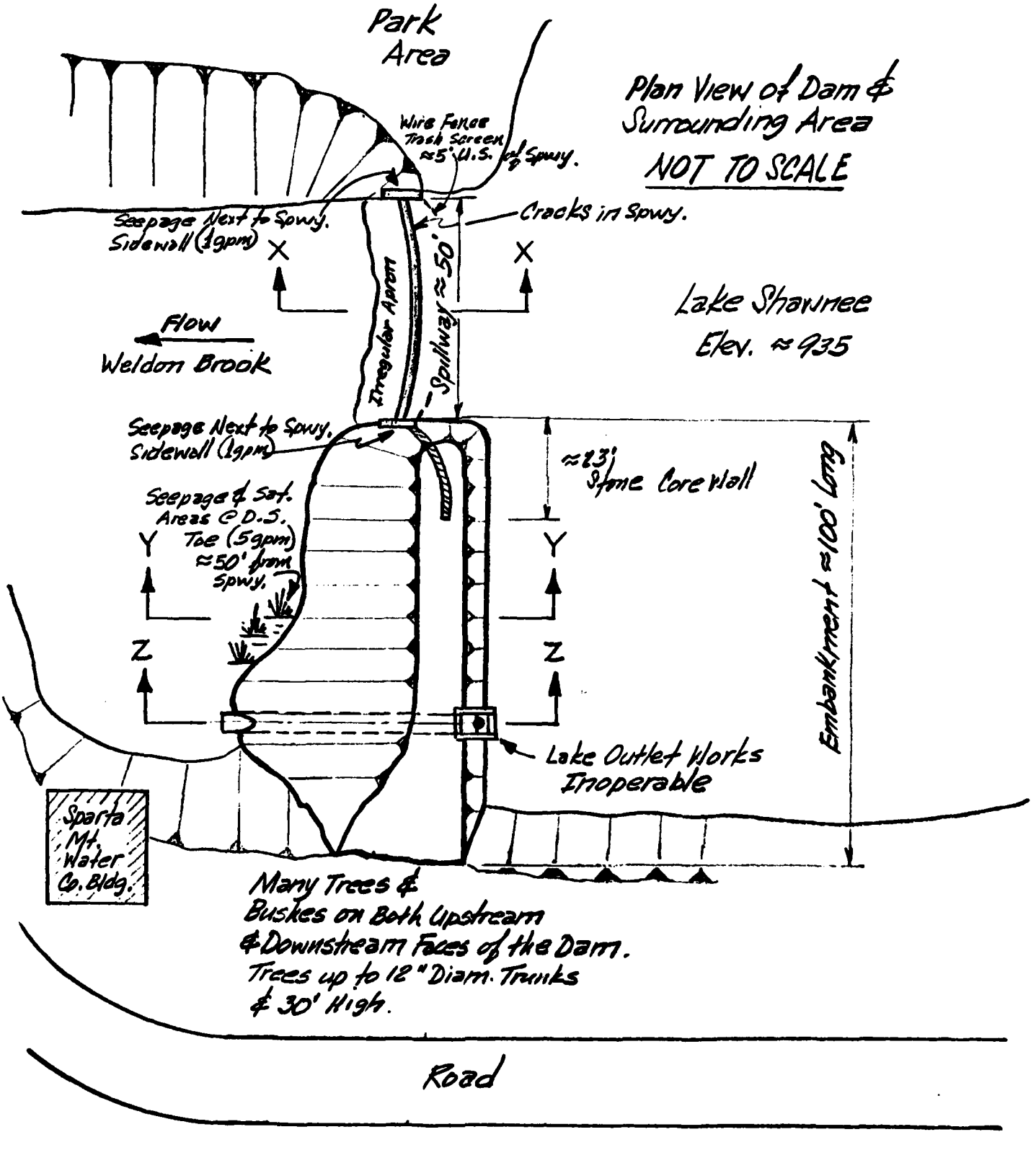
FIGURE 1

REGIONAL VICINITY MAP

SCALE 1·24000

O'BRIEN & GERE ENGINEERS, INC.

SUBJECT	SHEET	BY	DATE	JOB NO
Lake Shawnee Dam, Phila. COE, Open End	2	[illegible]	6/3/80	1800-006-103



O'BRIEN & GERE ENGINEERS, INC.

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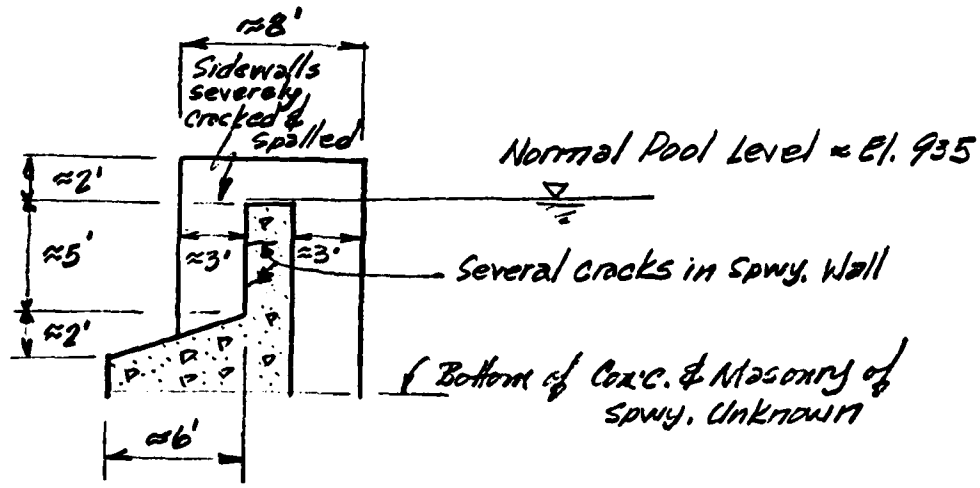
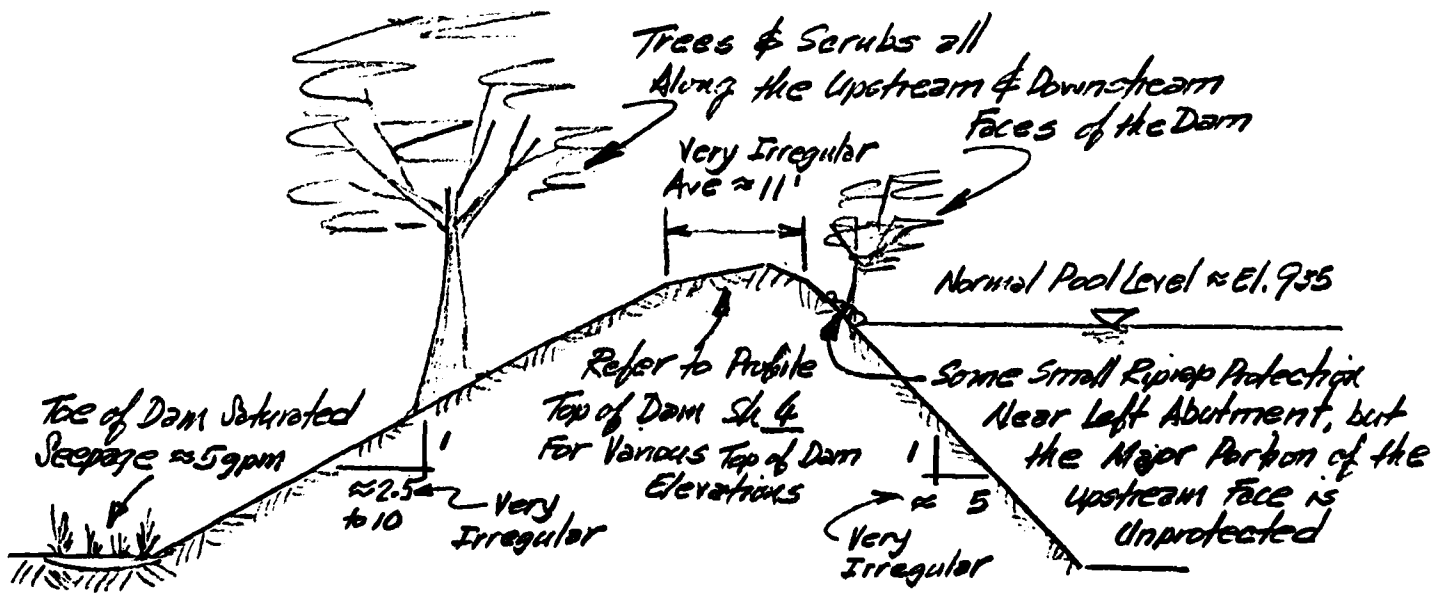
Lake Shawnee Dam, Phila. COE, Open End	3		6/3/80	1800-006-103



SECTION X-X NOT TO SCALE



SECTION Y-Y NOT TO SCALE

O'BRIEN & GERE ENGINEERS, INC.

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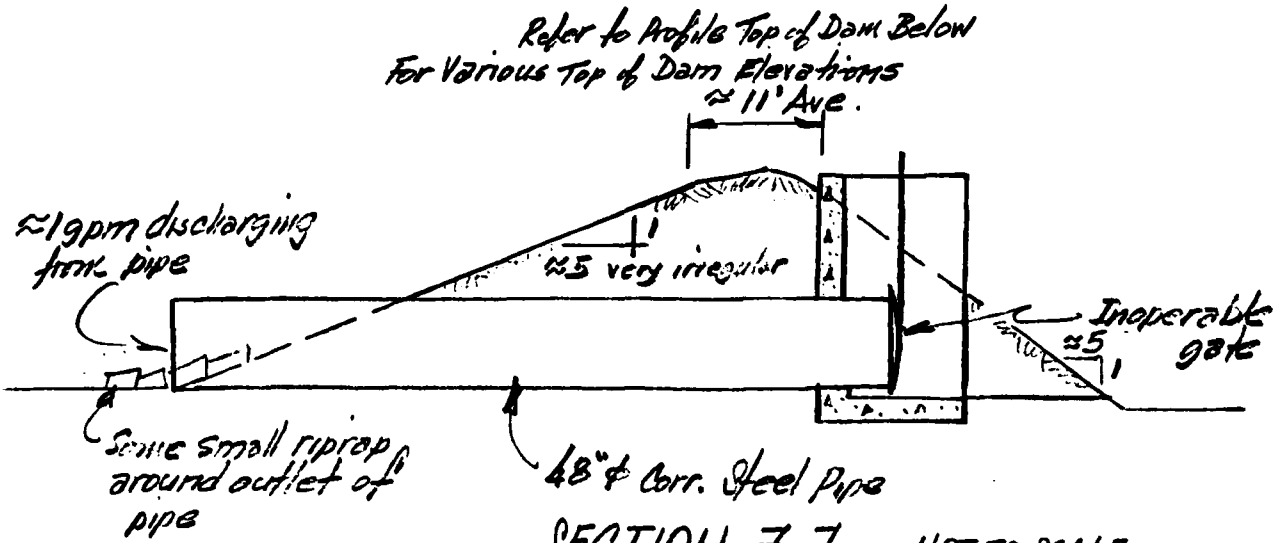
Lake Shawnee Dam, Phila COE, Open End	4	[illegible]	6/3/80	1800-006-103



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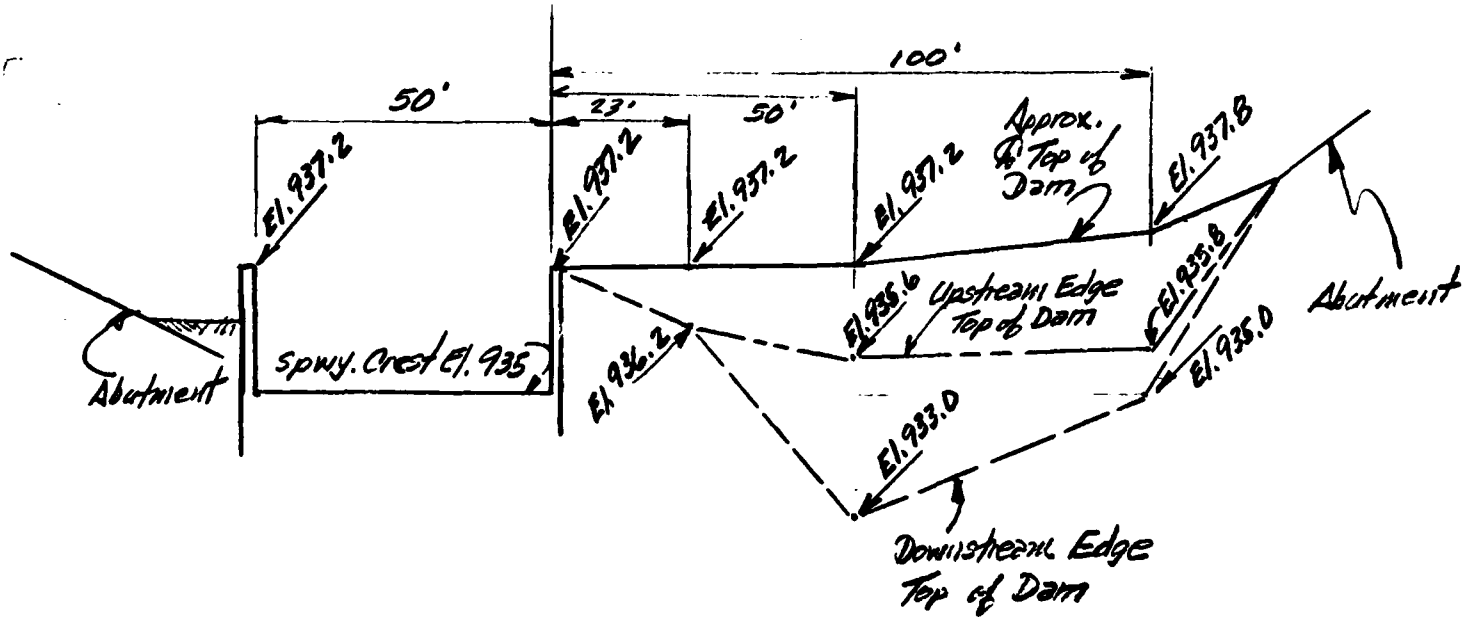

PROFILE TOP OF DAM

Scale 1" = 30' Hor'z.
1" = 3' Vert.

APPENDIX

F

Site Geology

SITE GEOLOGY

LAKE SHAWNEE DAM

Lake Shawnee Dam is located in the Middle Section of the Valley and Ridge physiographic province. The dam is located in a region of stratified drift from the Wisconsin Glacial Age which is primarily composed of sand and gravel plains, deltas, eskers, kames and terraces. The majority of the lake and the northern and western shores are underlain by Losee Gneiss which is an igneous rock of Pre-Cambrian origin. Numerous rock outcroppings are visible in these areas. No faults or major structural defects are noted in the vicinity of the dam or lake.

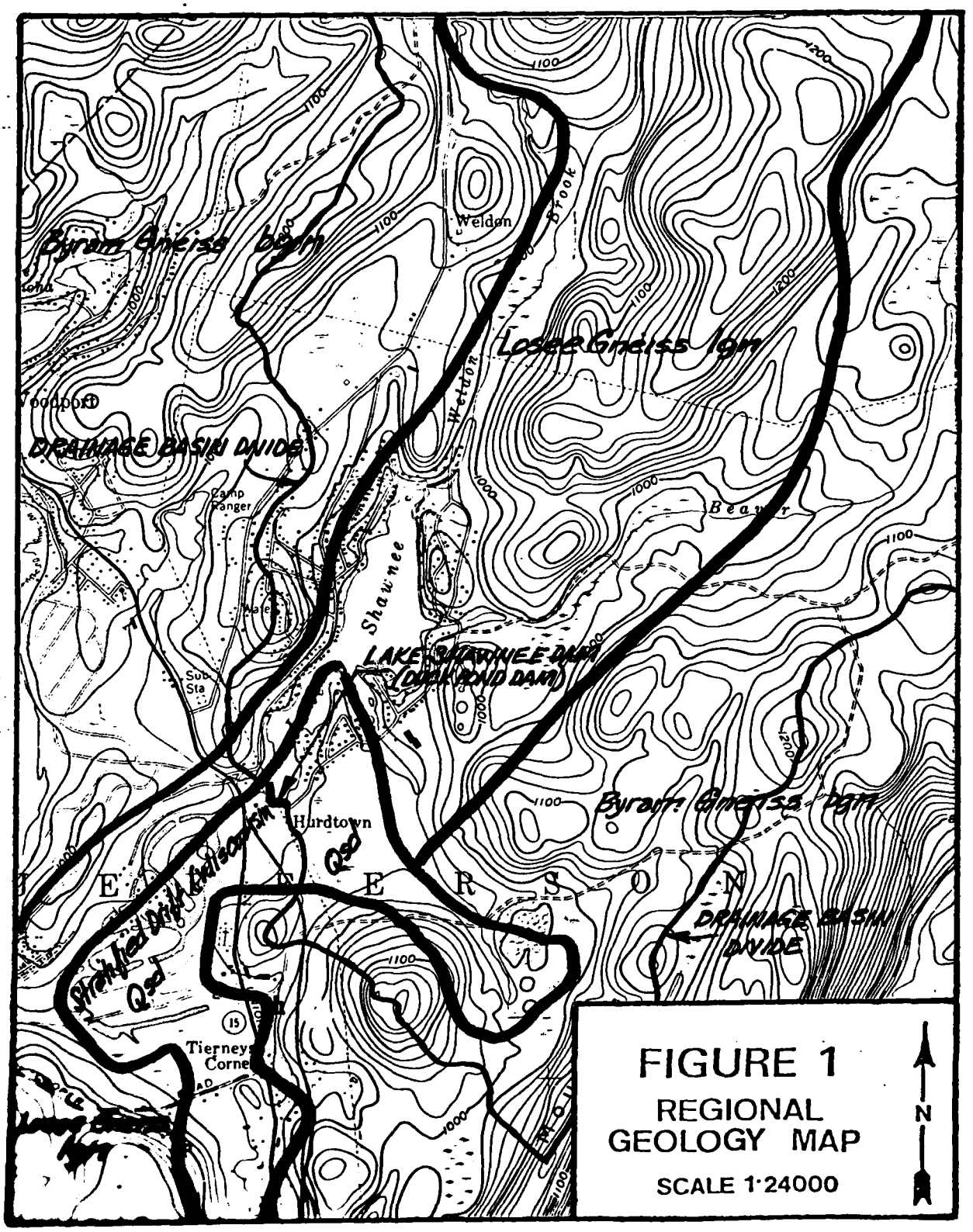

FIGURE 1

REGIONAL GEOLOGY MAP

SCALE 1:24000

N